

## Memorandum

|         |  |      |   |
|---------|--|------|---|
| To      | Rob Law, dmi   | Page | 1 |
| CC      | Bill Potter, dmi<br>Laura Kelmar, AECOM                          |      |   |
| Subject | Updated Exposure Assumption Tables Deliverable to USEPA Region 2 |      |   |
| From    | Betsy Ruffle and Kelly Vosnakis                                  |      |   |
| Date    | August 20, 2015  |      |   |

In response to USEPA Region 2's June 5, 2015 comments on the draft Baseline Human Health Risk Assessment (BHHRA) for the Lower Passaic River Study Area (LPRSA), AECOM has revised the exposure assumption tables of the draft BHHRA (Tables 4-1 to 4-7) to reflect updated guidance. As discussed with USEPA Region 2 on the June 15, 2015 technical call, the updated tables are being submitted to Region 2 with the Cooperating Parties Group's (CPG) responses to Region's 2 comments on the draft BHHRA. A summary of the updates is presented below with reference to the relevant comments. The updates to the tables are shown in yellow highlighting to aid in the review process (provided in the attachment to this memorandum).

### **Updates Based on 2014 Standard Default Exposure Factors Guidance (Comments 14, 68, 99, and 123)**

Tables 4-2 to 4-5 have been updated to use the updated Standard Default Exposure Factors that was published in February 2014 (with minor corrections in April 2015) (USEPA 2014). Based on the 2014 guidance, several default parameters for adults were updated, including body weight, worker body surface area, and exposure duration. In cases where the default values listed in USEPA 2014 are not based on the same age groups or exposed body parts as were assumed in the RARC, updated values were calculated using the latest Exposure Factors Handbook (EFH) (USEPA 2011)<sup>1</sup>. Tables documenting the calculations are presented in Attachment Tables 1 to 3. The calculations followed the same methodology and data used by USEPA in deriving the values for the 2014 Standard Default Exposure Factors.

Values that were updated to the defaults presented in USEPA 2014 are listed below:

- Adult body weight was updated from 70 kilograms (kg) (USEPA 1991) to 80 kg (USEPA 2014);
- Adult exposure duration was updated from 24 years (USEPA 1991) to 20 years (USEPA 2014);
- Adult (worker) body surface area for contact with sediment (hands, forearms and head) was updated from 3,300 cm<sup>2</sup> (USEPA 2002) to 3,527 cm<sup>2</sup> (USEPA 2014);

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<sup>1</sup> The ages of each receptor was clarified on the tables, for example, the young child, which previously said 1-6 yr, was updated to state 1<7 year.

- Adult (swimmer) total body surface area for contact with surface water was updated from 18,000 cm<sup>2</sup> (USEPA 1997, 2004) to 20,900 cm<sup>2</sup> (USEPA 2014).

References for other parameters that did not change were updated to reflect the 2014 document (i.e., child exposure duration, soil ingestion rates).

Per comment 99 and USEPA (2014), the default lifetime of 70 years has been maintained.

Note that the 2014 guidance does not provide exposure factors for older children, teens, or adolescents, or for recreational scenarios.

**Updates Based on 2011 Exposure Factors Handbook (Comments 29 (2<sup>nd</sup> bullet), 64 (1<sup>st</sup> paragraph), and 69a)**

Specific parameters in Tables 4-2 to 4-5 have been updated from the 2008 Child EFH (USEPA 2008) to the 2011 EFH (USEPA 2011), which replaced the 2008 document. While not specifically requested in the comments, references to the 1997 version of the EFH (USEPA 1997) have also been updated to the 2011 EFH (USEPA 2011) in order to ensure the most up-to-date values are used. In most cases, this was simply a matter of changing USEPA 1997 or USEPA 2008 to USEPA 2011. However, there were also numerical changes based on this update, as follows:

**Body Weight**

- The default body weight of 15 kg for young children listed in USEPA 2014 is based on children ranging in age from birth to the day before the 6<sup>th</sup> birthday. However, the young child assumed to be potentially exposed to media in the LPRSA is assumed to range in age from the first birthday to the day before the 7<sup>th</sup> birthday. Therefore, the young child (age 1<7) body weight was updated to 19 kg, based on data from the 2011 EFH for ages 1<7. The calculations are provided in Attachment Table 1.
- The body weight for the older child (age 7<14) boater was updated to 43 kg (USEPA 2011) from 41 kg (USEPA 2008), as documented in Attachment Table 1.

**Body Surface Area**

- Updates to body surface areas for the young child, adolescent, older child, and teen, as documented in Attachment Table 2 and presented below:
  - Child (age 1<7) surface area for contact with sediment while swimming or wading (hands, lower legs, forearms, feet, and face) was updated to 2,272 cm<sup>2</sup> (USEPA 2011) from 2,500 cm<sup>2</sup> (USEPA 2008).
  - Child (age 1<7) whole body surface area for contact with surface water while swimming was updated to 7,517 cm<sup>2</sup> (USEPA 2011) from 6,600 cm<sup>2</sup> (USEPA 2008). As with body weights, the default whole body surface area presented in USEPA 2014 represents children aged 0<6, while the young child receptor for the LPRSA is aged 1<7.
  - Adolescent (age 7<19) surface area for contact with sediment while swimming or wading and for contact with surface water while wading (hands, lower legs, forearms, feet, and face) was updated to 4,436 cm<sup>2</sup> (USEPA 2011) from 5,100 cm<sup>2</sup> (USEPA 2008).
  - Adolescent (age 7<19) whole body surface area for contact with surface water while swimming was updated to 15,192 cm<sup>2</sup> (USEPA 2011) from 14,800 cm<sup>2</sup> (USEPA 2008).

- Older child (age 7<14) surface area for contact with sediment and surface water while boating (hands, lower legs, forearms, feet, and face) was updated to 3,942 (cm<sup>2</sup>) (USEPA 2011) from 4,400 cm<sup>2</sup> (USEPA 2008).
  - Teen (age 14<19) surface area for contact with sediment and surface water while boating (hands, forearms, and face) was updated to 1,992 cm<sup>2</sup> (USEPA 2011) from 2,500 cm<sup>2</sup> (USEPA 2008).
- Updates to body surface areas for the adult, as documented in Attachment Table 3 and presented below:
  - Adult body surface area for contact with sediment (angler, swimmer, wader) and surface water (angler, wader) (face, hands, forearms, lower legs, and feet) was updated to 6,492 cm<sup>2</sup> (USEPA 2011) from 6,100 cm<sup>2</sup> (USEPA 1997). Note that the adult surface area presented in USEPA 2014 does not include the surface area of the feet.
  - Adult boater surface area for contact with sediment and surface water (hands, forearms, and face) was updated to 2,670 cm<sup>2</sup> (USEPA 2011) from 2,500 cm<sup>2</sup> (USEPA 1997).

#### Surface Water Ingestion Rate

Based on USEPA 2008, USEPA Region 2 selected surface water ingestion rates of 0.05 liters per hour (L/hr) for swimmer receptors, and one-half of the swimming rate (0.025 L/hr) for all other receptors. The same ingestion rates were applied across all age groups. The 2011 EFH provides swimming ingestion rates for both children and adults (0.049 L/hr for children aged 6-15 and 0.021 L/hr for adults). Based on USEPA (2011), the surface water ingestion rate for the adult receptors has been updated as follows:

- Adult swimmer = 0.021 L/hr
- Adult wader, boater, angler = 0.011 L/hr

#### Editorial Updates (Comments 176 to 181)

- Table 4-1 was updated to include language regarding inhalation of vapors (comment 176).
- CF2 was removed from Table 4-3 (comment 177).
- The intake equation which was included in the RARC was updated to reflect the dermally absorbed dose equation that was used in the BHHRA (comment 178).
- The row height for exposure frequency on Table 4-4 was increased (comment 179).
- Table 4-6 was updated to correct the footnotes for antimony and aluminum to (c), and a new footnote (d) was added to reflect that the dermal absorption factors for DDD, DDE, aldrin, dieldrin, and heptachlor epoxide are the default values for semivolatile organic compounds from RAGS Part E Exhibit 3-4 (USEPA 2004). As USEPA (2004) is the original source of the value, we believe it is the appropriate reference, rather than the suggested reference to the USEPA regional screening level table (comment 180).
- The footnote row height in Table 4-7 was increased and the definitions of (b) and (c) were added to equations A-6 through A-8 (comment 181).

**References:**

USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", OSWER Directive 9285.6-03. [Replaced by USEPA 2014]

USEPA 1997. Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa. [Replaced by USEPA 2011]

USEPA 2002. Supplemental Guidance Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA 2004. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment. USEPA/540/R/99/005

USEPA 2008. Child Specific Exposure Factors Handbook. EPA 600/R-06/096F. [Replaced by USEPA 2011 and USEPA 2014].

USEPA 2011. Exposure Factors Handbook: 2011 Edition. USEPA/600/R-09/052F. September 2011.

USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**TABLE 4-1**  
**SELECTION OF EXPOSURE PATHWAYS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Scenario Timeframe | Medium       | Exposure Medium                      | Exposure Point                                      | Receptor Population | Receptor Age                    | Exposure Route   | Type of Analysis                             | Rationale for Selection or Exclusion of Exposure Pathway   |
|--------------------|--------------|--------------------------------------|---|---------------------|---------------------------------|--|--|--|
| Current/Future     | Biota Tissue | Fish Tissue                          | Fish from 17-mile stretch of Passaic River          | Angler              | Child (1 < 7 years old)         | Ingestion  | Quantitative                                 | Site-related contaminants have been detected in fish. Studies have found that despite Fish Advisories, individuals do fish in the study area. Assumes receptor will consume fish caught from Passaic River and share it with family members.   |
|                    |              |                                      |   |                     | Adolescent (7 to <19 years old) | Ingestion  | Quantitative                                 |  |
|                    |              |                                      |   |                     | Adult (>18 years old)           | Ingestion  | Quantitative                                 |  |
|                    |              | Crab/shellfish Tissue                | Crabs from 17-mile stretch of Passaic River         | Angler              | Child (1 < 7 years old)         | Ingestion  | Quantitative                                 | Site-related contaminants have been detected in crabs/shellfish. Studies have found that despite Fish Advisories, individuals do collect crabs from the study area. Assumes receptor will consume crabs/shellfish gathered from Passaic River and share them with family members.  |
|                    |              |                                      |   |                     | Adolescent (7 to <19 years old) | Ingestion  | Quantitative                                 |  |
|                    |              |                                      |   |                     | Adult (>18 years old)           | Ingestion  | Quantitative                                 |  |
|                    |              | Turtles, ducks, etc.                 | Other species from 17-mile stretch of Passaic River | Angler              | Child (1 < 7 years old)         | Ingestion  | Qualitative                                  | Limited data; ingestion of animals other than Passaic River fish/crabs likely to be minimal.   |
|                    |              |                                      |   |                     | Adolescent (7 to <19 years old) | Ingestion  | Qualitative                                  |  |
|                    |              |                                      |   |                     | Adult (>18 years old)           | Ingestion  | Qualitative                                  |  |
|                    |              | Fish/crab/other species              | Fish/crab/other species                             | Transient Person    | Multiple ages                   | Ingestion  | Qualitative                                  | Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section.  |
|                    | Sediment     | River Sediment, Mudflat Sediment (1) | 17-mile stretch of Passaic River (3)                | Angler              | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Angler may contact sediment while fishing or crabbing from the river bank. Assumes that young children (1 to 6 years) would not typically accompany adult anglers due to safety concerns. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible. |
|                    |              |                                      |   |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                    |              |                                      |   |                     |                                 |  |  |  |

**TABLE 4-1**  
**SELECTION OF EXPOSURE PATHWAYS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Scenario Timeframe         | Medium   | Exposure Medium                      | Exposure Point                       | Receptor Population | Receptor Age                    | Exposure Route   | Type of Analysis                             | Rationale for Selection or Exclusion of Exposure Pathway   |
|----------------------------|----------|--------------------------------------|--------------------------------------|---------------------|---------------------------------|--|--|--|
| Current/Future (continued) | Sediment | River Sediment, Mudflat Sediment (1) | 17-mile stretch of Passaic River (3) | Swimmer             | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Swimming is included in the designated uses of the freshwater portion of the river from the confluence with Second River to Dundee Dam (i.e., RM 8 to RM 17) (FW2-NT) (2). Swimming could also occur in other portions of the river. Swimmers may contact sediment while entering and leaving the river and while swimming. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |          |                                      |                                      |                     | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      | Wader               | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Families visiting riverside parks may contact sediment along the river. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |          |                                      |                                      |                     | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      | Boater              | Older child (7 <14 years old)   | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Recreational boating is included in the designated uses of the Passaic River throughout the study area (FW2-NT, SE2, SE3) (2), and could include kayaking, canoeing, rowing/sculling. Eight high school sculling teams and two boating clubs use the river for rowing. Children (ages 7 to 13 years) may also participate in recreational boating. Docks are typically used, but boaters may occasionally contact sediment when a boat flips and wading is necessary. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible. |
|                            |          |                                      |                                      |                     | Teen (14 <19 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |          |                                      |                                      | Worker              | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact                         | Quantitative<br>Quantitative                 | Workers may be tasked with collecting shoreline trash or other work that leads to contact with sediment along the river. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible. Contact with surface water is not typically expected to occur.   |
|                            |          |                                      |                                      |                     |                                 | Inhalation of Vapors   | Quantitative                                 |  |

**TABLE 4-1**  
**SELECTION OF EXPOSURE PATHWAYS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Scenario Timeframe         | Medium        | Exposure Medium                      | Exposure Point                       | Receptor Population | Receptor Age                    | Exposure Route   | Type of Analysis                             | Rationale for Selection or Exclusion of Exposure Pathway   |
|----------------------------|---------------|--------------------------------------|--------------------------------------|---------------------|---------------------------------|--|--|--|
| Current/Future (continued) | Sediment      | River Sediment, Mudflat Sediment (1) | 17-mile stretch of Passaic River (3) | Resident            | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Qualitative<br>Qualitative<br>Qualitative    | Residential properties are located adjacent to the river, especially above RM 10. Residents may contact river sediment during activities near their homes. Potential risks are addressed qualitatively. The inhalation pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |               |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Qualitative<br>Qualitative<br>Qualitative    |  |
|                            |               |                                      |                                      | Transient Person    | Multiple ages                   | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Qualitative<br>Qualitative<br>Qualitative    | Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section. The inhalation pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |               |                                      |                                      |                     |                                 |  |  |  |
|                            | Surface Water | Surface Water                        | 17-mile stretch of Passaic River     | Angler              | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Anglers may contact surface water while fishing or crabbing from the river bank. Assumes that young children (1 to 6 years) would not typically accompany adult anglers due to safety concerns. Inhalation may occur if volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |               |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |               |                                      |                                      | Swimmer             | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Swimming is included in the designated uses of the freshwater portion of the river from the confluence with Second River to Dundee Dam (i.e., RM 8 to RM 17) (FW2-NT) (2). Swimming could also occur in other portions of the river. Swimmers may contact surface water while swimming. Inhalation may occur if volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible. |
|                            |               |                                      |                                      |                     |                                 | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |               |                                      |                                      |                     | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |
|                            |               |                                      |                                      |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |  |

**TABLE 4-1**  
**SELECTION OF EXPOSURE PATHWAYS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Scenario Timeframe         | Medium        | Exposure Medium | Exposure Point                   | Receptor Population | Receptor Age                    | Exposure Route   | Type of Analysis                             | Rationale for Selection or Exclusion of Exposure Pathway  |
|----------------------------|---------------|-----------------|----------------------------------|---------------------|---------------------------------|--|--|---|
| Current/Future (continued) | Surface Water | Surface Water   | 17-mile stretch of Passaic River | Wader               | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Families visiting riverside parks may contact surface water along the river. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.   |
|                            |               |                 |                                  |                     | Adolescent (7 to <19 years old) | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |   |
|                            |               |                 |                                  |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |   |
|                            |               |                 |                                  | Boater              | Older child (7 <14 years old)   | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative | Recreational boating is included in the designated uses of the Passaic River throughout the study area (FW2-NT, SE2, SE3) (2), and could include kayaking, canoeing, rowing/sculling. Eight high school sculling teams and two boating clubs use the river for rowing. Children (ages 7 to 13 years) may also participate in recreational boating. Boaters may contact surface water while boating and occasionally when entering or leaving their crafts. Inhalation may occur if activities are in mudflat areas and volatiles are present, however, this pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible. |
|                            |               |                 |                                  |                     | Teen (14 <19 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |   |
|                            |               |                 |                                  |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Quantitative<br>Quantitative<br>Quantitative |   |
|                            |               |                 |                                  | Resident            | Child (1 < 7 years old)         | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Qualitative<br>Qualitative<br>Qualitative    | Residential properties are located adjacent to the river, especially above RM 10. Surface water from the river is not used as a domestic water supply. Residents may contact surface water during activities near their homes. Potential risks are addressed qualitatively. The inhalation pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.  |
|                            |               |                 |                                  |                     | Adult (>18 years old)           | Incidental Ingestion<br>Dermal Contact<br>Inhalation of Vapors | Qualitative<br>Qualitative<br>Qualitative    |   |
|                            |               |                 |                                  | Transient Person    | Multiple ages                   | Incidental Ingestion   | Qualitative                                  | Evidence of homeless camps has been observed in the study area. Limited exposure pattern data would make quantification highly uncertain. Potential risks relative to other receptors are discussed in the uncertainty section. The inhalation pathway is not considered further in the BHHRA because the inhalation pathway risks are negligible.  |
|                            |               |                 |                                  |                     |                                 | Dermal Contact   | Qualitative                                  |   |
|                            |               |                 |                                  |                     |                                 | Inhalation of Vapors   | Qualitative                                  |   |

*This table was originally provided by USEPA on September 10, 2010; it is reproduced with minor editorial updates and clarifications, and to reflect revisions provided by USEPA on February 10, 2011 February 6, 2012, and comments provided on June 5, 2015.*

RM - River Mile.

- (1) River sediment is defined as nearshore sediment under 2 feet of water or less at mean low water. Nearshore river and mudflat sediment are combined and treated as one media, referred to as accessible surface sediment, in the baseline human health risk assessment.
- (2) NJAC 7:9B Surface Water Quality Standards classification for the Passaic River:
  - Mouth of river to Second River (RM 0 to RM 8) is classified as saline-estuarine 3 (SE3). Designated use for SE3 water includes secondary contact recreation: recreational activities where the probability of water ingestion is minimal and includes, but is not limited to, boating and fishing.
  - Second River to Dundee Dam (RM 8 to RM 17) is classified as freshwater 2 non-trout (FW2-NT) and saline-estuarine 2 (SE2). Designated use for FW2-NT and SE2 water includes secondary contact recreation (e.g., boating and fishing). Designated use for FW2-NT water also includes primary contact recreation: recreational activities that involve significant ingestion risks and includes, but is not limited to, wading, swimming, diving, surfing, and water skiing.
- (3) Accessible sediments were evaluated on both a sitewide basis and an exposure area basis, where the Study Area was divided into six three-mile segments (RM 0-3, 3-6, 6-9, 9-12, 12-15, 15-17.4).



TABLE 4-2  
VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route       | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition               | Unit      | RME               |   | CTE               |                                  | Intake Equation   |
|----------------------|---------------------|-----------------------------|----------------|----------------|------------------------------------|-----------|-------------------|---|-------------------|----------------------------------|---|
|                      |                     |                             |                |                |                                    |           | Value             | Rationale/ Reference                                      | Value             | Rationale/ Reference             |   |
| Incidental Ingestion | Angler              | Adolescent<br>(7 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br>CS x CF1 x IR-S x EF x ED x<br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                      |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                      |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                      |                     |                             |                | EF             | Exposure Frequency                 | days/year | 39                | 3 days/week, 3 month/year                                 | 20                | Approximately 50% of RME         |   |
|                      |                     |                             |                | ED             | Exposure Duration                  | years     | 12                | (1)   | 6                 | 50% of RME                       |   |
|                      |                     |                             |                | BW             | Body Weight                        | kg        | 52                | USEPA 2011 (mean, ages 7<19)                              | 52                | USEPA 2011 (mean, ages 7<19)     |   |
|                      |                     |                             |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                      |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 4,380             | ED (year) x 365 days/year                                 | 2,190             | ED (year) x 365 days/year        |   |
|                      |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br>CS x CF1 x IR-S x EF x ED x<br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                      |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                      |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                      |                     |                             |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                      |                     |                             |                | ED             | Exposure Duration                  | years     | 20                | USEPA 2014  | 9                 | USEPA 1989                       |   |
|                      | Swimmer             | Child<br>(1 <7 year)        | Sediment       | BW             | Body Weight                        | kg        | 80                | USEPA 2014  | 80                | USEPA 2014                       | Intake (mg/kg-day) =<br>CS x CF1 x IR-S x EF x ED x<br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                      |                     |                             |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                      |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 7,300             | ED (year) x 365 days/year                                 | 3,285             | ED (year) x 365 days/year        |   |
|                      |                     |                             |                | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                |   |
|                      |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                      |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 100               | 50% of the default residential child soil IR (USEPA 2014) | 50                | 50% of RME                       |   |
|                      |                     |                             |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                      |                     | Adult<br>(>18 year)         | Sediment       | ED             | Exposure Duration                  | years     | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME                       |   |
|                      |                     |                             |                | BW             | Body Weight                        | kg        | 19                | USEPA 2011 (mean, ages 1<7)                               | 19                | USEPA 2011 (mean, ages 1<7)      |   |
|                      |                     |                             |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                      |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 2,190             | ED (year) x 365 days/year                                 | 1,095             | ED (year) x 365 days/year        |   |

TABLE 4-2  
VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route                   | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition               | Unit      | RME               |   | CTE               |                                  | Intake Equation   |
|----------------------------------|---------------------|-----------------------------|----------------|----------------|------------------------------------|-----------|-------------------|---|-------------------|----------------------------------|---|
|                                  |                     |                             |                |                |                                    |           | Value             | Rationale/ Reference                                      | Value             | Rationale/ Reference             |   |
| Incidental Ingestion (continued) | Swimmer             | Adolescent<br>(7 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br>$CS \times CF1 \times IR-S \times EF \times ED \times 1/BW \times 1/AT$<br><br>Arsenic intakes are also multiplied by an RBA of 0.6 (3) |
|                                  |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                                  |                     |                             |                | EF             | Exposure Frequency                 | days/year | 39                | 3 days/week, 3 month/year                                 | 20                | Approximately 50% of RME         |   |
|                                  |                     |                             |                | ED             | Exposure Duration                  | years     | 12                | (1)   | 6                 | 50% of RME                       |   |
|                                  |                     |                             |                | BW             | Body Weight                        | kg        | 52                | USEPA 2011 (mean, ages 7<19)                              | 52                | USEPA 2011 (mean, ages 7<19)     |   |
|                                  |                     |                             |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                                  |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 4,380             | ED (year) x 365 days/year                                 | 2,190             | ED (year) x 365 days/year        |   |
|                                  |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br>$CS \times CF1 \times IR-S \times EF \times ED \times 1/BW \times 1/AT$<br><br>Arsenic intakes are also multiplied by an RBA of 0.6 (3) |
|                                  |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                                  |                     |                             |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                                  |                     |                             |                | ED             | Exposure Duration                  | years     | 20                | USEPA 2014  | 9                 | USEPA 1989                       |   |
|                                  |                     |                             |                | BW             | Body Weight                        | kg        | 80                | USEPA 2014  | 80                | USEPA 2014                       |   |
|                                  | Wader               | Child<br>(1 < 7 year)       | Sediment       | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year | Intake (mg/kg-day) =<br>$CS \times CF1 \times IR-S \times EF \times ED \times 1/BW \times 1/AT$<br><br>Arsenic intakes are also multiplied by an RBA of 0.6 (3) |
|                                  |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 7,300             | ED (year) x 365 days/year                                 | 3,285             | ED (year) x 365 days/year        |   |
|                                  |                     |                             |                | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                |   |
|                                  |                     |                             |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                             |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 100               | 50% of the default residential child soil IR (USEPA 2014) | 50                | 50% of RME                       |   |
|                                  |                     |                             |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                                  |                     |                             |                | ED             | Exposure Duration                  | years     | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME                       |   |
|                                  |                     |                             |                | BW             | Body Weight                        | kg        | 19                | USEPA 2011 (mean, ages 1<7)                               | 19                | USEPA 2011 (mean, ages 1<7)      |   |
|                                  |                     |                             |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                                  |                     |                             |                | AT-N           | Averaging Time (Noncancer)         | days      | 2,190             | ED (year) x 365 days/year                                 | 1,095             | ED (year) x 365 days/year        |   |

**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route                   | Receptor Population | Receptor Age                 | Exposure Point | Parameter Code | Parameter Definition               | Unit      | RME               |   | CTE               |                                  | Intake Equation   |
|----------------------------------|---------------------|------------------------------|----------------|----------------|------------------------------------|-----------|-------------------|---|-------------------|----------------------------------|---|
|                                  |                     |                              |                |                |                                    |           | Value             | Rationale/ Reference                                      | Value             | Rationale/ Reference             |   |
| Incidental Ingestion (continued) | Wader               | Adolescent<br>(7 < 19 year)  | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                                  |                     |                              |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                              |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                                  |                     |                              |                | EF             | Exposure Frequency                 | days/year | 39                | 3 days/week, 3 month/year                                 | 20                | Approximately 50% of RME         |   |
|                                  |                     |                              |                | ED             | Exposure Duration                  | years     | 12                | (1)   | 6                 | 50% of RME                       |   |
|                                  |                     |                              |                | BW             | Body Weight                        | kg        | 52                | USEPA 2011 (mean, ages 7<19)                              | 52                | USEPA 2011 (mean, ages 7<19)     |   |
|                                  |                     |                              |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                                  |                     |                              |                | AT-N           | Averaging Time (Noncancer)         | days      | 4,380             | ED (year) x 365 days/year                                 | 2,190             | ED (year) x 365 days/year        |   |
|                                  |                     | Adult<br>(>18 year)          | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                                  |                     |                              |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                              |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                                  |                     |                              |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                                  |                     |                              |                | ED             | Exposure Duration                  | years     | 20                | USEPA 2014  | 9                 | USEPA 1989                       |   |
|                                  |                     |                              |                | BW             | Body Weight                        | kg        | 80                | USEPA 2014  | 80                | USEPA 2014                       |   |
|                                  | Boater              | Older Child<br>(7 < 14 year) | Sediment       | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                                  |                     |                              |                | AT-N           | Averaging Time (Noncancer)         | days      | 7,300             | ED (year) x 365 days/year                                 | 3,285             | ED (year) x 365 days/year        |   |
|                                  |                     |                              |                | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT<br><br>Arsenic intakes are also multiplied<br>by an RBA of 0.6 (3) |
|                                  |                     |                              |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |   |
|                                  |                     |                              |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential child soil IR (USEPA 2014) | 25                | 50% of RME                       |   |
|                                  |                     |                              |                | EF             | Exposure Frequency                 | days/year | 13                | 1 day/week, 3 months/year                                 | 7                 | Approximately 50% of RME         |   |
|                                  |                     |                              |                | ED             | Exposure Duration                  | years     | 7                 | (1)   | 3                 | Approximately 50% of RME         |   |
|                                  |                     |                              |                | BW             | Body Weight                        | kg        | 43                | USEPA 2011 (mean, ages 7<14)                              | 43                | USEPA 2011 (mean, ages 7<14)     |   |
|                                  |                     |                              |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |   |
|                                  |                     |                              |                | AT-N           | Averaging Time (Noncancer)         | days      | 2,555             | ED (year) x 365 days/year                                 | 1,095             | ED (year) x 365 days/year        |   |

**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route                   | Receptor Population | Receptor Age           | Exposure Point | Parameter Code | Parameter Definition               | Unit      | RME               |   | CTE               |                                  | Intake Equation  |
|----------------------------------|---------------------|------------------------|----------------|----------------|------------------------------------|-----------|-------------------|---|-------------------|----------------------------------|--|
|                                  |                     |                        |                |                |                                    |           | Value             | Rationale/ Reference                                      | Value             | Rationale/ Reference             |  |
| Incidental Ingestion (continued) | Boater              | Teen<br>(14 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT |
|                                  |                     |                        |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |  |
|                                  |                     |                        |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |  |
|                                  |                     |                        |                | EF             | Exposure Frequency                 | days/year | 4                 | 1 day/month, 3.5 months                                   | 2                 | Approximately 50% of RME         |  |
|                                  |                     |                        |                | ED             | Exposure Duration                  | years     | 5                 | (1)   | 3                 | Approximately 50% of RME         |  |
|                                  |                     |                        |                | BW             | Body Weight                        | kg        | 66                | USEPA 2011 (mean, ages 14<19)                             | 66                | USEPA 2011 (mean, ages 14<19)    |  |
|                                  |                     |                        |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |  |
|                                  |                     |                        |                | AT-N           | Averaging Time (Noncancer)         | days      | 1,825             | ED (year) x 365 days/year                                 | 1,095             | ED (year) x 365 days/year        |  |
|                                  |                     | Adult<br>(> 18 year)   | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT |
|                                  |                     |                        |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |  |
|                                  |                     |                        |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default residential adult soil IR (USEPA 2014) | 25                | 50% of RME                       |  |
|                                  |                     |                        |                | EF             | Exposure Frequency                 | days/year | 9                 | 1 day/month, 8.5 months                                   | 4                 | Approximately 50% of RME         |  |
|                                  |                     |                        |                | ED             | Exposure Duration                  | years     | 20                | USEPA 2014  | 9                 | USEPA 1989                       |  |
|                                  |                     |                        |                | BW             | Body Weight                        | kg        | 80                | USEPA 2014  | 80                | USEPA 2014                       |  |
|                                  |                     |                        |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |  |
|                                  |                     |                        |                | AT-N           | Averaging Time (Noncancer)         | days      | 7,300             | ED (year) x 365 days/year                                 | 3,285             | ED (year) x 365 days/year        |  |
|                                  | Worker              | Adult<br>(> 18 year)   | Sediment       | CS             | Chemical Concentration in Sediment | mg/kg     | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                | Intake (mg/kg-day) =<br><br>CS x CF1 x IR-S x EF x ED x<br><br>1/BW x 1/AT |
|                                  |                     |                        |                | CF1            | Conversion Factor 1                | kg/mg     | 1E-06             | --  | 1E-06             | --                               |  |
|                                  |                     |                        |                | IR-S           | Ingestion Rate of Sediment         | mg/day    | 50                | 50% of the default outdoor worker soil IR (USEPA 2014)    | 25                | 50% of RME                       |  |
|                                  |                     |                        |                | EF             | Exposure Frequency                 | days/year | 50                | 1 day/week, 50 weeks/year                                 | 25                | 50% of RME                       |  |
|                                  |                     |                        |                | ED             | Exposure Duration                  | years     | 25                | USEPA 2014  | 7                 | USEPA 2011                       |  |
|                                  |                     |                        |                | BW             | Body Weight                        | kg        | 80                | USEPA 2014  | 80                | USEPA 2014                       |  |
|                                  |                     |                        |                | AT-C           | Averaging Time (Cancer)            | days      | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year |  |
|                                  |                     |                        |                | AT-N           | Averaging Time (Noncancer)         | days      | 9,125             | ED (year) x 365 days/year                                 | 2,555             | ED (year) x 365 days/year        |  |

TABLE 4-2  
VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit               | RME               |   | CTE               |   | Intake Equation   |
|----------------|---------------------|-----------------------------|----------------|----------------|---|--------------------|-------------------|---|-------------------|---|---|
|                |                     |                             |                |                |   |                    | Value             | Rationale/ Reference  | Value             | Rationale/ Reference  |   |
| Dermal         | Angler              | Adolescent<br>(7 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         |   |
|                |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 39                | 3 days/week, 3 month/year   | 20                | Approximately 50% of RME  |   |
|                |                     |                             |                | ED             | Exposure Duration                       | years              | 12                | (1)   | 6                 | 50% of RME  |   |
|                |                     |                             |                | BW             | Body Weight                             | kg                 | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |   |
|                |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             |   |
|                |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 |   |
|                |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                |                     |                             |                | ED             | Exposure Duration                       | years              | 20                | USEPA 2014  | 9                 | USEPA 1989  |   |
|                |                     |                             |                | BW             | Body Weight                             | kg                 | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |   |

**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route        | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit               | RME               |   | CTE               |   | Intake Equation   |
|-----------------------|---------------------|-----------------------------|----------------|----------------|---|--------------------|-------------------|---|-------------------|---|---|
|                       |                     |                             |                |                |   |                    | Value             | Rationale/ Reference  | Value             | Rationale/ Reference  |   |
| Dermal<br>(continued) | Swimmer             | Child<br>(1 <7 year)        | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)                          | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)                          |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 19                | USEPA 2011 (mean, ages 1<7)   | 19                | USEPA 2011 (mean, ages 1<7)   |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 2,190             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                       |                     | Adolescent<br>(7 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 39                | 3 days/week, 3 month/year   | 20                | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 12                | (1)   | 6                 | 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |   |
|                       |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 20                | USEPA 2014  | 9                 | USEPA 1989  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |   |

**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route        | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit               | RME               |   | CTE               |   | Intake Equation   |
|-----------------------|---------------------|-----------------------------|----------------|----------------|---|--------------------|-------------------|---|-------------------|---|---|
|                       |                     |                             |                |                |   |                    | Value             | Rationale/ Reference  | Value             | Rationale/ Reference  |   |
| Dermal<br>(continued) | Wader               | Child<br>(1 <7 year)        | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)                          | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)                          |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 19                | USEPA 2011 (mean, ages 1<7)   | 19                | USEPA 2011 (mean, ages 1<7)   |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 2,190             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                       |                     | Adolescent<br>(7 < 19 year) | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 39                | 3 days/week, 3 month/year   | 20                | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 12                | (1)   | 6                 | 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |   |
|                       |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)                             |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 20                | USEPA 2014  | 9                 | USEPA 1989  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |   |

**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route        | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit               | RME               |   | CTE               |   | Intake Equation   |
|-----------------------|---------------------|-----------------------------|----------------|----------------|---|--------------------|-------------------|---|-------------------|---|---|
|                       |                     |                             |                |                |   |                    | Value             | Rationale/ Reference  | Value             | Rationale/ Reference  |   |
| Dermal<br>(continued) | Boater              | Older Child<br>(7 <14 year) | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 3,942             | Mean value for 7<14 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         | 3,942             | Mean value for 7<14 years: face, hands, forearms, lower legs, feet (USEPA 2011)                         |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 7                 | (1)   | 3                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 43                | USEPA 2011 (mean, ages 7<14)  | 43                | USEPA 2011 (mean, ages 7<14)  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 2,555             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                       |                     | Teen<br>(14 <19 year)       | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 1,992             | Mean value for 14<19 years: face, hands, forearms (USEPA 2011)  | 1,992             | Mean value for 14<19 years: face, hands, forearms (USEPA 2011)  |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) | 0.2               | 50th percentile surface area weighted soil adherence data for children playing in wet soil (USEPA 2004) |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 4                 | 1 day/month, 3.5 months   | 2                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 5                 | (1)   | 3                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 66                | USEPA 2011 (mean, ages 14<19)   | 66                | USEPA 2011 (mean, ages 14<19)   |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 1,825             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                       |                     | Adult<br>(>18 year)         | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 2,692             | Mean value for adults: face, hands, forearms (USEPA 2011)   | 2,692             | Mean value for adults: face, hands, forearms (USEPA 2011)   |   |
|                       |                     |                             |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004)                 |   |
|                       |                     |                             |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year          | 9                 | 1 day/month, 8.5 months   | 4                 | Approximately 50% of RME  |   |
|                       |                     |                             |                | ED             | Exposure Duration                       | years              | 20                | USEPA 2014  | 9                 | USEPA 1989  |   |
|                       |                     |                             |                | BW             | Body Weight                             | kg                 | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days               | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |   |



**TABLE 4-2**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SEDIMENT**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                             |
|---------------------|-----------------------------|
| Scenario Timeframe: | Current/Future              |
| Medium:             | Sediment                    |
| Exposure Medium:    | Accessible Surface Sediment |

| Exposure Route        | Receptor Population | Receptor Age        | Exposure Point | Parameter Code | Parameter Definition                    | Unit               | RME               |   | CTE               |   | Intake Equation   |
|-----------------------|---------------------|---------------------|----------------|----------------|---|--------------------|-------------------|---|-------------------|---|---|
|                       |                     |                     |                |                |   |                    | Value             | Rationale/ Reference  | Value             | Rationale/ Reference  |   |
| Dermal<br>(continued) | Worker              | Adult<br>(>18 year) | Sediment       | CS             | Chemical Concentration in Sediment      | mg/kg              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br><br>CS x CF1 x SA x AF x ABS x<br><br>EF x ED x 1/BW x 1/AT |
|                       |                     |                     |                | CF1            | Conversion Factor 1                     | kg/mg              | 1E-06             | --  | 1E-06             | --  |   |
|                       |                     |                     |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>    | 3,527             | Mean default value for workers: head, hands, forearms (USEPA 2014)                      | 3,527             | Mean default value for workers: head, hands, forearms (USEPA 2014)                      |   |
|                       |                     |                     |                | AF             | Adherence Factor                        | mg/cm <sup>2</sup> | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004) | 0.3               | 50% value for adult (reed gatherer): hands, lower legs, forearms, and feet (USEPA 2004) |   |
|                       |                     |                     |                | ABS            | Absorption Factor                       | unitless           | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                       |                     |                     |                | EF             | Exposure Frequency                      | days/year          | 50                | 1 day/week, 50 wks/year   | 25                | 50% of RME  |   |
|                       |                     |                     |                | ED             | Exposure Duration                       | years              | 25                | USEPA 2014  | 7                 | USEPA 2011  |   |
|                       |                     |                     |                | BW             | Body Weight                             | kg                 | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                       |                     |                     |                | AT-C           | Averaging Time (Cancer)                 | days               | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                       |                     |                     |                | AT-N           | Averaging Time (Noncancer)              | days               | 9,125             | ED (year) x 365 days/year   | 2,555             | ED (year) x 365 days/year   |   |

This table was originally provided by USEPA on September 10, 2010; it is reproduced with editorial updates and clarifications, and to reflect revisions provided by USEPA on February 10, 2011 and February 6, 2012.

In addition, the table has been revised to reflect current USEPA guidance as of June 2015, per USEPA comments dated June 5, 2015.

The references, naming conventions and units used by USEPA for each parameter have been retained; in some cases, parameter names and intake equations differ from the report text.

The inhalation of outdoor air pathway is evaluated via a screening assessment in Appendix D; based on the findings that the air pathway poses negligible risk, the exposure pathway assumptions have been removed from this table.

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure

(1) Based on age group of receptor.

(2) Professional judgment.

(3) Recommendations for Default Value for Relative Bioavailability (RBA) of Arsenic in Soil. OSWER Directive 9200.1-113. USEPA, December 2012. Consistent with the approach used by the June 2015 Regional Screening Level (RSL) table (USEPA, 2015b).

Sources:

USEPA 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. USEPA/540/1-89/002

USEPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA 2004: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Final. USEPA/540/R/99/005

USEPA 2011: Exposure Factors Handbook: 2011 Edition. USEPA/600/R-09/052F. September 2011.

USEPA 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition            | Unit      | RME               |  | CTE               |  | Intake Equation   |
|----------------|---------------------|-----------------------------|----------------|----------------|---------------------------------|-----------|-------------------|--|-------------------|--|---|
|                |                     |                             |                |                |                                 |           | Value             | Reference  | Value             | Reference  |   |
| Ingestion      | Angler              | Adolescent<br>(7 < 19 year) | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                |                     |                             |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) |   |
|                |                     |                             |                | ET             | Exposure Time                   | hours/day | 1.0               | (2)  | 0.5               | (2)  |   |
|                |                     |                             |                | EF             | Exposure Frequency              | days/year | 39                | 3 day/week, 3 months/year  | 20                | Approximately 50% of RME   |   |
|                |                     |                             |                | ED             | Exposure Duration               | years     | 12                | (1)  | 6                 | 50% of RME   |   |
|                |                     |                             |                | BW             | Body Weight                     | kg        | 52                | USEPA 2011 (mean, ages 7<19)                                     | 52                | USEPA 2011 (mean, ages 7<19)                                     |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)      | days      | 4,380             | ED (year) x 365 days/year  | 2,190             | ED (year) x 365 days/year  |   |
|                |                     | Adult<br>(≥18 year)         | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                |                     |                             |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.011             | 50% of the mean swimming rate for adults (USEPA 2011)            | 0.011             | 50% of the mean swimming rate for adults (USEPA 2011)            |   |
|                |                     |                             |                | ET             | Exposure Time                   | hours/day | 1.0               | (2)  | 0.5               | (2)  |   |
|                |                     |                             |                | EF             | Exposure Frequency              | days/year | 13                | 1 day/week, 3 months/year  | 7                 | Approximately 50% of RME   |   |
|                |                     |                             |                | ED             | Exposure Duration               | years     | 20                | USEPA 2014   | 9                 | USEPA 1989   |   |
|                |                     |                             |                | BW             | Body Weight                     | kg        | 80                | USEPA 2014   | 80                | USEPA 2014   |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)      | days      | 7,300             | ED (year) x 365 days/year  | 3,285             | ED (year) x 365 days/year  |   |
|                | Swimmer             | Child<br>(1 < 7 year)       | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                |                     |                             |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.05              | mean swimming rate for children 6-15 yrs (USEPA 2011)            | 0.05              | mean swimming rate for children 6-15 yrs (USEPA 2011)            |   |
|                |                     |                             |                | ET             | Exposure Time                   | hours/day | 2.6               | National average for swimming (USEPA 1989)                       | 2.6               | National average for swimming (USEPA 1989)                       |   |
|                |                     |                             |                | EF             | Exposure Frequency              | days/year | 13                | 1 day/week, 3 months/year  | 7                 | Approximately 50% of RME   |   |
|                |                     |                             |                | ED             | Exposure Duration               | years     | 6                 | USEPA 2014 (1)   | 3                 | 50% of RME   |   |
|                |                     |                             |                | BW             | Body Weight                     | kg        | 19                | USEPA 2011 (mean, ages 1<7)                                      | 19                | USEPA 2011 (mean, ages 1<7)                                      |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)      | days      | 2,190             | ED (year) x 365 days/year  | 1,095             | ED (year) x 365 days/year  |   |
|                |                     | Adolescent<br>(7 < 19 year) | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                |                     |                             |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                |                     |                             |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.05              | mean swimming rate for children 6-15 yrs (USEPA 2011)            | 0.05              | mean swimming rate for children 6-15 yrs (USEPA 2011)            |   |
|                |                     |                             |                | ET             | Exposure Time                   | hours/day | 2.6               | National average for swimming (USEPA 1989)                       | 2.6               | National average for swimming (USEPA 1989)                       |   |
|                |                     |                             |                | EF             | Exposure Frequency              | days/year | 39                | 3 day/week, 3 months/year  | 20                | Approximately 50% of RME   |   |
|                |                     |                             |                | ED             | Exposure Duration               | years     | 12                | (1)  | 6                 | 50% of RME   |   |
|                |                     |                             |                | BW             | Body Weight                     | kg        | 52                | USEPA 2011 (mean, ages 7<19)                                     | 52                | USEPA 2011 (mean, ages 7<19)                                     |   |
|                |                     |                             |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                |                     |                             |                | AT-N           | Averaging Time (Noncancer)      | days      | 4,380             | ED (year) x 365 days/year  | 2,190             | ED (year) x 365 days/year  |   |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route        | Receptor Population | Receptor Age             | Exposure Point | Parameter Code | Parameter Definition            | Unit      | RME               |  | CTE               |  | Intake Equation   |
|-----------------------|---------------------|--------------------------|----------------|----------------|---------------------------------|-----------|-------------------|--|-------------------|--|---|
|                       |                     |                          |                |                |                                 |           | Value             | Reference  | Value             | Reference  |   |
| Ingestion (continued) | Swimmer             | Adult (>18 year)         | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                       |                     |                          |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                       |                     |                          |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.021             | mean swimming rate for adults (USEPA 2011)                       | 0.021             | mean swimming rate for adults (USEPA 2011)                       |   |
|                       |                     |                          |                | ET             | Exposure Time                   | hours/day | 2.6               | National average for swimming (USEPA 1989)                       | 2.6               | National average for swimming (USEPA 1989)                       |   |
|                       |                     |                          |                | EF             | Exposure Frequency              | days/year | 13                | 1 day/week, 3 months/year  | 7                 | Approximately 50% of RME   |   |
|                       |                     |                          |                | ED             | Exposure Duration               | years     | 20                | USEPA 2014   | 9                 | USEPA 1989   |   |
|                       |                     |                          |                | BW             | Body Weight                     | kg        | 80                | USEPA 2014   | 80                | USEPA 2014   |   |
|                       |                     |                          |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                       |                     |                          |                | AT-N           | Averaging Time (Noncancer)      | days      | 7,300             | ED (year) x 365 days/year  | 3,285             | ED (year) x 365 days/year  |   |
|                       |                     |                          |                |                |                                 |           |                   |  |                   |  |   |
|                       | Wader               | Child (1 <7 year)        | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                       |                     |                          |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                       |                     |                          |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) |   |
|                       |                     |                          |                | ET             | Exposure Time                   | hours/day | 1.0               | (2)  | 0.5               | (2)  |   |
|                       |                     |                          |                | EF             | Exposure Frequency              | days/year | 13                | 1 day/week, 3 months/year  | 7                 | Approximately 50% of RME   |   |
|                       |                     |                          |                | ED             | Exposure Duration               | years     | 6                 | USEPA 2014 (1)   | 3                 | 50% of RME   |   |
|                       |                     |                          |                | BW             | Body Weight                     | kg        | 19                | USEPA 2011 (mean, ages 1<7)                                      | 19                | USEPA 2011 (mean, ages 1<7)                                      |   |
|                       |                     |                          |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                       |                     |                          |                | AT-N           | Averaging Time (Noncancer)      | days      | 2,190             | ED (year) x 365 days/year  | 1,095             | ED (year) x 365 days/year  |   |
|                       |                     |                          |                |                |                                 |           |                   |  |                   |  |   |
|                       |                     | Adolescent (7 < 19 year) | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                       |                     |                          |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                       |                     |                          |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011) |   |
|                       |                     |                          |                | ET             | Exposure Time                   | hours/day | 1.0               | (2)  | 0.5               | (2)  |   |
|                       |                     |                          |                | EF             | Exposure Frequency              | days/year | 39                | 3 day/week, 3 months/year  | 20                | Approximately 50% of RME   |   |
|                       |                     |                          |                | ED             | Exposure Duration               | years     | 12                | (1)  | 6                 | 50% of RME   |   |
|                       |                     |                          |                | BW             | Body Weight                     | kg        | 52                | USEPA 2011 (mean, ages 7<19)                                     | 52                | USEPA 2011 (mean, ages 7<19)                                     |   |
|                       |                     |                          |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                       |                     |                          |                | AT-N           | Averaging Time (Noncancer)      | days      | 4,380             | ED (year) x 365 days/year  | 2,190             | ED (year) x 365 days/year  |   |
|                       |                     |                          |                |                |                                 |           |                   |  |                   |  |   |
|                       |                     | Adult (>18 year)         | Surface Water  | CW             | Chemical Concentration in Water | µg/L      | chemical-specific | chemical-specific  | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT |
|                       |                     |                          |                | CF1            | Conversion Factor 1             | mg/µg     | 0.001             | --   | 0.001             | --   |   |
|                       |                     |                          |                | IR-W           | Ingestion Rate of Water         | L/hour    | 0.011             | 50% of the mean swimming rate for adults (USEPA 2011)            | 0.011             | 50% of the mean swimming rate for adults (USEPA 2011)            |   |
|                       |                     |                          |                | ET             | Exposure Time                   | hours/day | 1.0               | (2)  | 0.5               | (2)  |   |
|                       |                     |                          |                | EF             | Exposure Frequency              | days/year | 13                | 1 day/week, 3 months/year  | 7                 | Approximately 50% of RME   |   |
|                       |                     |                          |                | ED             | Exposure Duration               | years     | 20                | USEPA 2014   | 9                 | USEPA 1989   |   |
|                       |                     |                          |                | BW             | Body Weight                     | kg        | 80                | USEPA 2014   | 80                | USEPA 2014   |   |
|                       |                     |                          |                | AT-C           | Averaging Time (Cancer)         | days      | 25,550            | 70-year lifetime x 365 days/year                                 | 25,550            | 70-year lifetime x 365 days/year                                 |   |
|                       |                     |                          |                | AT-N           | Averaging Time (Noncancer)      | days      | 7,300             | ED (year) x 365 days/year  | 3,285             | ED (year) x 365 days/year  |   |
|                       |                     |                          |                |                |                                 |           |                   |  |                   |  |   |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route           | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit              | RME               |   | CTE               |   | Intake Equation   |
|--------------------------|---------------------|-----------------------------|----------------|----------------|---|-------------------|-------------------|---|-------------------|---|---|
|                          |                     |                             |                |                |   |                   | Value             | Reference   | Value             | Reference   |   |
| Ingestion<br>(continued) | Boater              | Older Child<br>(7 <14 year) | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT   |
|                          |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |   |
|                          |                     |                             |                | IR-W           | Ingestion Rate of Water                 | L/hour            | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011)                | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011)                |   |
|                          |                     |                             |                | ET             | Exposure Time                           | hours/day         | 2                 | (3)   | 1.5               | (3)   |   |
|                          |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |   |
|                          |                     |                             |                | ED             | Exposure Duration                       | years             | 7                 | (1)   | 3                 | Approximately 50% of RME  |   |
|                          |                     |                             |                | BW             | Body Weight                             | kg                | 43                | USEPA 2011 (mean, ages 7<14)  | 43                | USEPA 2011 (mean, ages 7<14)  |   |
|                          |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                          |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 2,555             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                          |                     |                             |                | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   |   |
|                          |                     | Teen<br>(14 <19 year)       | Surface Water  | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT   |
|                          |                     |                             |                | IR-W           | Ingestion Rate of Water                 | L/hour            | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011)                | 0.025             | 50% of the mean swimming rate for children age 6-15 (USEPA 2011)                |   |
|                          |                     |                             |                | ET             | Exposure Time                           | hours/day         | 2                 | (3)   | 1.5               | (3)   |   |
|                          |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 98                | 7 days/wk for 14 weeks (3)  | 70                | 5 days/wk for 14 weeks (3)  |   |
|                          |                     |                             |                | ED             | Exposure Duration                       | years             | 5                 | (1)   | 3                 | Approximately 50% of RME  |   |
|                          |                     |                             |                | BW             | Body Weight                             | kg                | 66                | USEPA 2011 (mean, ages 14<19)   | 66                | USEPA 2011 (mean, ages 14<19)   |   |
|                          |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                          |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 1,825             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |   |
|                          |                     |                             |                | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   |   |
|                          |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |   |
|                          |                     | Adult<br>(>18 year)         | Surface Water  | IR-W           | Ingestion Rate of Water                 | L/hour            | 0.011             | 50% of the mean swimming rate for adults (USEPA 2011)                           | 0.011             | 50% of the USEPA 2011 mean for adults   | Intake (mg/kg-day) =<br>CW x CF1 x IR-W x ET x EF x ED<br><br>x 1/BW x 1/AT   |
|                          |                     |                             |                | ET             | Exposure Time                           | hours/day         | 2                 | (3)   | 1.5               | (3)   |   |
|                          |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 259               | 7 days/wk for 37 weeks (3)  | 111               | 3 days/wk for 37 weeks (3)  |   |
|                          |                     |                             |                | ED             | Exposure Duration                       | years             | 20                | USEPA 2014  | 9                 | USEPA 1989  |   |
|                          |                     |                             |                | BW             | Body Weight                             | kg                | 80                | USEPA 2014  | 80                | USEPA 2014  |   |
|                          |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                          |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |   |
|                          |                     |                             |                | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   |   |
|                          |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |   |
|                          |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011) | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011) |   |
| Dermal                   | Angler              | Adolescent<br>(7 <19 year)  | Surface Water  | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  | Dermally Absorbed Dose (mg/kg-day) =<br><br>DAevent x EF x EV x ED x SA<br><br>x 1/BW x 1/AT<br><br><u>Inorganics:</u><br><br>DAevent = CW x PC x ET x CF2<br><br><u>Organics:</u><br><br>If ET ≤ 1', then DAevent =<br>2 FA x PC x CW x CF2<br>x [square root (6T x ET/πe)]<br><br>If ET > 1', then DAevent =<br>FA x PC x CW x CF2 x [(ET/(1 + B)) + 2T<br>x ((1 + 3B + 3B <sup>2</sup> )/(1 + B) <sup>2</sup> )] |
|                          |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                          |                     |                             |                | t*             | Time to reach steady state, 24t         | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                          |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                          |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |   |
|                          |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |   |
|                          |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 1.0               | (2)   | 0.5               | (2)   |   |
|                          |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 39                | 3 day/week, 3 months/year   | 20                | Approximately 50% of RME  |   |
|                          |                     |                             |                | ED             | Exposure Duration                       | years             | 12                | (1)   | 6                 | 50% of RME  |   |
|                          |                     |                             |                | BW             | Body Weight                             | kg                | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |   |
|                          |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |   |
|                          |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |   |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route        | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit              | RME               |   | CTE               |   | Intake Equation  |
|-----------------------|---------------------|-----------------------------|----------------|----------------|---|-------------------|-------------------|---|-------------------|---|--|
|                       |                     |                             |                |                |   |                   | Value             | Reference   | Value             | Reference   |  |
| Dermal<br>(continued) | Angler              | Adult<br>(>18 year)         | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B2)/(1+B2))]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011) | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011) |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 1.0               | (2)   | 0.5               | (2)   |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 20                | USEPA 2014  | 9                 | USEPA 1989  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 80                | USEPA 2014  | 80                | USEPA 2014  |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |  |
|                       | Swimmer             | Child<br>(1 < 7 year)       | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B2)/(1+B2))]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 7,517             | Mean value for 1<7 years: whole body (USEPA 2011)                           | 7,517             | Mean value for 1<7 years: whole body (USEPA 2011)                           |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 2.6               | National average for swimming (USEPA 1989)                                  | 2.6               | National average for swimming (USEPA 1989)                                  |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 19                | USEPA 2011 (mean, ages 1<7)   | 19                | USEPA 2011 (mean, ages 1<7)   |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 2,190             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |  |
|                       |                     | Adolescent<br>(7 < 19 year) | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B2)/(1+B2))]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 15,192            | Mean value for 7<18 years: whole body (USEPA 2011)                          | 15,192            | Mean value for 7<18 years: whole body (USEPA 2011)                          |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 2.6               | National average for swimming (USEPA 1989)                                  | 2.6               | National average for swimming (USEPA 1989)                                  |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 39                | 3 day/week, 3 months/year   | 20                | Approximately 50% of RME  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 12                | (1)   | 6                 | 50% of RME  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |  |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route        | Receptor Population | Receptor Age               | Exposure Point | Parameter Code | Parameter Definition                    | Unit              | RME               |   | CTE               |   | Intake Equation  |
|-----------------------|---------------------|----------------------------|----------------|----------------|---|-------------------|-------------------|---|-------------------|---|--|
|                       |                     |                            |                |                |   |                   | Value             | Reference   | Value             | Reference   |  |
| Dermal<br>(continued) |                     | Adult<br>(>18 year)        | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B^2))]$ |
|                       |                     |                            |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 20,900            | Resident default whole body (USEPA 2014)  | 20,900            | Resident default whole body (USEPA 2014)  |  |
|                       |                     |                            |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | ET             | Exposure Time                           | hrs/day           | 2.6               | National average for swimming (USEPA 1989)                                      | 2.6               | National average for swimming (USEPA 1989)                                      |  |
|                       |                     |                            |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                            |                | ED             | Exposure Duration                       | years             | 20                | USEPA 2014  | 9                 | USEPA 1989  |  |
|                       |                     |                            |                | BW             | Body Weight                             | kg                | 80                | USEPA 2014  | 80                | USEPA 2014  |  |
|                       |                     |                            |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                            |                | AT-N           | Averaging Time (Noncancer)              | days              | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |  |
|                       | Wader               | Child<br>(1 <7 year)       | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B^2))]$ |
|                       |                     |                            |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)  | 2,272             | Mean value for 1<7 years: face, hands, forearms, lower legs, feet (USEPA 2011)  |  |
|                       |                     |                            |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | ET             | Exposure Time                           | hrs/day           | 1.0               | (2)   | 0.5               | (2)   |  |
|                       |                     |                            |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                            |                | ED             | Exposure Duration                       | years             | 6                 | USEPA 2014 (1)  | 3                 | 50% of RME  |  |
|                       |                     |                            |                | BW             | Body Weight                             | kg                | 19                | USEPA 2011 (mean, ages 1<7)   | 19                | USEPA 2011 (mean, ages 1<7)   |  |
|                       |                     |                            |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                            |                | AT-N           | Averaging Time (Noncancer)              | days              | 2,190             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |  |
|                       |                     | Adolescent<br>(7 <19 year) | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B^2))]$ |
|                       |                     |                            |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011) | 4,436             | Mean value for 7<18 years: face, hands, forearms, lower legs, feet (USEPA 2011) |  |
|                       |                     |                            |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                            |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                            |                | ET             | Exposure Time                           | hrs/day           | 1.0               | (2)   | 0.5               | (2)   |  |
|                       |                     |                            |                | EF             | Exposure Frequency                      | days/year         | 39                | 3 day/week, 3 months/year   | 20                | Approximately 50% of RME  |  |
|                       |                     |                            |                | ED             | Exposure Duration                       | years             | 12                | (1)   | 6                 | 50% of RME  |  |
|                       |                     |                            |                | BW             | Body Weight                             | kg                | 52                | USEPA 2011 (mean, ages 7<19)  | 52                | USEPA 2011 (mean, ages 7<19)  |  |
|                       |                     |                            |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                            |                | AT-N           | Averaging Time (Noncancer)              | days              | 4,380             | ED (year) x 365 days/year   | 2,190             | ED (year) x 365 days/year   |  |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route        | Receptor Population | Receptor Age                | Exposure Point | Parameter Code | Parameter Definition                    | Unit              | RME               |   | CTE               |   | Intake Equation  |
|-----------------------|---------------------|-----------------------------|----------------|----------------|---|-------------------|-------------------|---|-------------------|---|--|
|                       |                     |                             |                |                |   |                   | Value             | Reference   | Value             | Reference   |  |
| Dermal<br>(continued) |                     | Adult<br>(>18 year)         | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF_2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF_2 \times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF_2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B)^2)]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)     | 6,492             | Mean value for adults: face, hands, forearms, lower legs, feet (USEPA 2011)     |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 1.0               | (2)   | 0.5               | (2)   |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 20                | USEPA 2014  | 9                 | USEPA 1989  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 80                | USEPA 2014  | 80                | USEPA 2014  |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 7,300             | ED (year) x 365 days/year   | 3,285             | ED (year) x 365 days/year   |  |
|                       | Boater              | Older Child<br>(7 <14 year) | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF_2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF_2 \times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF_2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B)^2)]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 3,942             | Mean value for 7<14 years: face, hands, forearms, lower legs, feet (USEPA 2011) | 3,942             | Mean value for 7<14 years: face, hands, forearms, lower legs, feet (USEPA 2011) |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 2                 | (3)   | 1.5               | (3)   |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 13                | 1 day/week, 3 months/year   | 7                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 7                 | (1)   | 3                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 43                | USEPA 2011 (mean, ages 7<14)  | 43                | USEPA 2011 (mean, ages 7<14)  |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 2,555             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |  |
|                       |                     | Teen<br>(14 < 19 year)      | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF_2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} = 2 FA \times PC \times CW \times CF_2 \times [\text{square root } (6T \times ET/\text{pie})]$<br><br>If $ET > t^*$ , then $DA_{event} = FA \times PC \times CW \times CF_2 \times [(ET/(1+B)) + 2T \times ((1+3B+3B^2)/(1+B)^2)]$ |
|                       |                     |                             |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 1,992             | Mean value for 14<19 years: face, hands, forearms (USEPA 2011)                  | 1,992             | Mean value for 14<19 years: face, hands, forearms (USEPA 2011)                  |  |
|                       |                     |                             |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                             |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                             |                | ET             | Exposure Time                           | hrs/day           | 2                 | (3)   | 1.5               | (3)   |  |
|                       |                     |                             |                | EF             | Exposure Frequency                      | days/year         | 98                | 7 days/wk for 14 weeks (3)  | 70                | 5 days/wk for 14 weeks (3)  |  |
|                       |                     |                             |                | ED             | Exposure Duration                       | years             | 5                 | (1)   | 3                 | Approximately 50% of RME  |  |
|                       |                     |                             |                | BW             | Body Weight                             | kg                | 66                | USEPA 2011 (mean, ages 14<19)   | 66                | USEPA 2011 (mean, ages 14<19)   |  |
|                       |                     |                             |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year  |  |
|                       |                     |                             |                | AT-N           | Averaging Time (Noncancer)              | days              | 1,825             | ED (year) x 365 days/year   | 1,095             | ED (year) x 365 days/year   |  |

**TABLE 4-3**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - SURFACE WATER**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                |
|---------------------|----------------|
| Scenario Timeframe: | Current/Future |
| Medium:             | Surface Water  |
| Exposure Medium:    | Surface Water  |

| Exposure Route        | Receptor Population | Receptor Age        | Exposure Point | Parameter Code | Parameter Definition                    | Unit              | RME               |   | CTE               |   | Intake Equation  |
|-----------------------|---------------------|---------------------|----------------|----------------|---|-------------------|-------------------|---|-------------------|---|--|
|                       |                     |                     |                |                |   |                   | Value             | Reference   | Value             | Reference   |  |
| Dermal<br>(continued) |                     | Adult<br>(>18 year) | Surface Water  | CW             | Chemical Concentration in Water         | µg/L              | chemical-specific | chemical-specific   | chemical-specific | chemical-specific   | Dermal Absorbed Dose (mg/kg-day) =<br>$DA_{event} \times EF \times EV \times ED \times SA$<br><br>$\times 1/BW \times 1/AT$<br><br><u>Inorganics:</u><br>$DA_{event} = CW \times PC \times ET \times CF2$<br><br><u>Organics:</u><br>If $ET \leq t^*$ , then $DA_{event} =$<br>$2 FA \times PC \times CW \times CF2$<br>$\times [\text{square root } (6T \times ET/\pi)]$<br><br>If $ET > t^*$ , then $DA_{event} =$<br>$FA \times PC \times CW \times CF2 \times [(ET/(1 + B)) + 2T$<br>$\times ((1 + 3B + 3B2)/(1 + B2))]$ |
|                       |                     |                     |                | CF1            | Conversion Factor 1                     | mg/µg             | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                     |                | SA             | Skin Surface Area Available for Contact | cm <sup>2</sup>   | 2,692             | Mean value for adults: face, hands, forearms (USEPA 2011) | 2,692             | Mean value for adults: face, hands, forearms (USEPA 2011) |  |
|                       |                     |                     |                | PC             | Permeability Coefficient                | cm/hr             | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                     |                | FA             | Fraction absorbed water                 | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                     |                | t*             | Time to reach steady state, 2.4t        | hour              | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                     |                | T              | lag time                                | hour/event        | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                     |                | B              | Relative contribution of PC             | unitless          | Chemical-specific | USEPA 2004  | Chemical-specific | USEPA 2004  |  |
|                       |                     |                     |                | CF2            | Conversion Factor 2                     | L/cm <sup>3</sup> | 0.001             | --  | 0.001             | --  |  |
|                       |                     |                     |                | ET             | Exposure Time                           | hrs/day           | 2                 | (3)   | 1.5               | (3)   |  |
|                       |                     |                     |                | EF             | Exposure Frequency                      | days/year         | 259               | 7 days/wk for 37 weeks (3)                                | 111               | 3 days/wk for 37 weeks (3)                                |  |
|                       |                     |                     |                | ED             | Exposure Duration                       | years             | 20                | USEPA 2014  | 9                 | USEPA 1989  |  |
|                       |                     |                     |                | BW             | Body Weight                             | kg                | 80                | USEPA 2014  | 80                | USEPA 2014  |  |
|                       |                     |                     |                | AT-C           | Averaging Time (Cancer)                 | days              | 25,550            | 70-year lifetime x 365 days/year                          | 25,550            | 70-year lifetime x 365 days/year                          |  |
|                       |                     |                     |                | AT-N           | Averaging Time (Noncancer)              | days              | 7,300             | ED (year) x 365 days/year                                 | 3,285             | ED (year) x 365 days/year                                 |  |

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In addition, the table has been revised to reflect current USEPA guidance as of June 2015, per USEPA comments dated June 5, 2015.

The references, naming conventions and units used by USEPA for each parameter have been retained; in some cases, parameter names and intake equations differ from the report text.

The inhalation of outdoor air pathway is evaluated via a screening assessment in Appendix D; based on the findings that the air pathway poses negligible risk, the exposure pathway assumptions have been removed from this table.

RME - Reasonable Maximum Exposure.

CTE - Central Tendency Exposure.

(1) Based on age group of receptor.

(2) Professional judgement.

(3) Based on information provided by rowing clubs that use the Passaic River.

(4) The table provided by USEPA did not include exposure time for ingestion; therefore, this parameter has been included based on the dermal water exposure times, since ingestion rates are hourly.

Sources:

USEPA 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. USEPA/540/1-89/002

USEPA 2002: Supplemental Guidance Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA 2004: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment. USEPA/540/R/99/005

USEPA 2011: Exposure Factors Handbook: 2011 Edition. USEPA/600/R-09/052F. September 2011.

USEPA 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.



TABLE 4-4  
VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - FISH TISSUE  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT

|                     |                      |
|---------------------|----------------------|
| Scenario Timeframe: | Current/Future       |
| Medium:             | Fish tissue          |
| Exposure Medium:    | Fish tissue (fillet) |

| Exposure Route | Receptor Population | Receptor Age                | Exposure Point | Parameter Code  | Parameter Definition           | Unit             | RME               |  | CTE               |  | Intake Equation  |
|----------------|---------------------|-----------------------------|----------------|-----------------|--------------------------------|------------------|-------------------|--|-------------------|--|--|
|                |                     |                             |                |                 |                                |                  | Value             | Rationale/ Reference                               | Value             | Rationale/ Reference                               |  |
| Ingestion      | Angler              | Child<br>(1 <7 year)        | Fish           | C <sub>i</sub>  | Chemical Concentration in Fish | mg/kg wet weight | chemical-specific | chemical-specific                                  | chemical-specific | chemical-specific                                  | Intake (mg/kg-day) =<br>$C_i \times CF \times IR_f \times FI \times (1 - \text{Loss}) \times EF \times ED \times 1/BW \times 1/AT$ |
|                |                     |                             |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --   | 1E-03             | --   |  |
|                |                     |                             |                | IR <sub>f</sub> | Ingestion Rate of Fish         | g/day            | 11.5              | 1/3 the adult ingestion rate (USEPA 2011)          | 1.3               | 1/3 the adult ingestion rate (USEPA 2011)          |  |
|                |                     |                             |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River        | 1                 | Assumes 100% exposure is from Passaic River        |  |
|                |                     |                             |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in fish              | chemical-specific | USEPA 2000   |  |
|                |                     |                             |                | EF              | Exposure Frequency             | days/year        | 365               | Fish ingestion rate already averaged over one year | 365               | Fish ingestion rate already averaged over one year |  |
|                |                     |                             |                | ED              | Exposure Duration              | years            | 6                 | USEPA 2014 (1)                                     | 3                 | 50% of RME   |  |
|                |                     |                             |                | BW              | Body Weight                    | kg               | 19                | USEPA 2011 (mean, ages 1<7)                        | 19                | USEPA 2011 (mean, ages 1<7)                        |  |
|                |                     |                             |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year                   | 25,550            | 70-year lifetime x 365 days/year                   |  |
|                |                     |                             |                | AT-N            | Averaging Time (Noncancer)     | days             | 2,190             | ED (years) x 365 days/year                         | 1,095             | ED (years) x 365 days/year                         |  |
|                |                     | Adolescent<br>(7 < 19 year) | Fish           | C <sub>i</sub>  | Chemical Concentration in Fish | mg/kg wet weight | chemical-specific | chemical-specific                                  | chemical-specific | chemical-specific                                  | Intake (mg/kg-day) =<br>$C_i \times CF \times IR_f \times FI \times (1 - \text{Loss}) \times EF \times ED \times 1/BW \times 1/AT$ |
|                |                     |                             |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --   | 1E-03             | --   |  |
|                |                     |                             |                | IR <sub>f</sub> | Ingestion Rate of Fish         | g/day            | 23.1              | 2/3 the adult ingestion rate (USEPA 2011)          | 2.6               | 2/3 the adult ingestion rate (USEPA 2011)          |  |
|                |                     |                             |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River        | 1                 | Assumes 100% exposure is from Passaic River        |  |
|                |                     |                             |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in fish              | chemical-specific | USEPA 2000   |  |
|                |                     |                             |                | EF              | Exposure Frequency             | days/year        | 365               | Fish ingestion rate already averaged over one year | 365               | Fish ingestion rate already averaged over one year |  |
|                |                     |                             |                | ED              | Exposure Duration              | years            | 12                | (1)  | 6                 | 50% of RME   |  |
|                |                     |                             |                | BW              | Body Weight                    | kg               | 52                | USEPA 2011 (mean, ages 7<19)                       | 52                | USEPA 2011 (mean, ages 7<19)                       |  |
|                |                     |                             |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year                   | 25,550            | 70-year lifetime x 365 days/year                   |  |
|                |                     |                             |                | AT-N            | Averaging Time (Noncancer)     | days             | 4,380             | ED (years) x 365 days/year                         | 2,190             | ED (years) x 365 days/year                         |  |

**TABLE 4-4**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - FISH TISSUE**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                      |
|---------------------|----------------------|
| Scenario Timeframe: | Current/Future       |
| Medium:             | Fish tissue          |
| Exposure Medium:    | Fish tissue (fillet) |

| Exposure Route        | Receptor Population | Receptor Age     | Exposure Point | Parameter Code  | Parameter Definition           | Unit             | RME               |   | CTE               |  | Intake Equation  |
|-----------------------|---------------------|------------------|----------------|-----------------|--------------------------------|------------------|-------------------|---|-------------------|--|--|
|                       |                     |                  |                |                 |                                |                  | Value             | Rationale/ Reference  | Value             | Rationale/ Reference   |  |
| Ingestion (continued) | Angler              | Adult (>18 year) | Fish           | C <sub>i</sub>  | Chemical Concentration in Fish | mg/kg wet weight | chemical-specific | chemical-specific   | chemical-specific | chemical-specific  | Intake (mg/kg-day) =<br><br>C <sub>i</sub> x CF x IR <sub>f</sub> x FI x (1-Loss) x EF x ED x<br><br>1/BW x 1/AT |
|                       |                     |                  |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --  | 1E-03             | --   |  |
|                       |                     |                  |                | IR <sub>f</sub> | Ingestion Rate of Fish         | g/day            | 34.6              | Average of 90th percentile estimates for consumers from USEPA Region 2 reanalysis of Burger 2002 (37.3 g/day) and Connelly et al. 1992 (32 g/day) | 3.9               | Average of 50th percentile for consumers from USEPA Region 2 reanalysis of Burger 2002 (3.7 g/day) and 50th percentile from Connelly et al. 1992 (4 g/day) |  |
|                       |                     |                  |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River   | 1                 | Assumes 100% exposure is from Passaic River  |  |
|                       |                     |                  |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in Fish   | chemical-specific | USEPA 2000   |  |
|                       |                     |                  |                | EF              | Exposure Frequency             | days/year        | 365               | Fish ingestion rate already averaged over one year  | 365               | Fish ingestion rate already averaged over one year   |  |
|                       |                     |                  |                | ED              | Exposure Duration              | years            | 20                | USEPA 2014 (2)  | 9                 | USEPA 1989   |  |
|                       |                     |                  |                | BW              | Body Weight                    | kg               | 80                | USEPA 2014  | 80                | USEPA 2014   |  |
|                       |                     |                  |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year  | 25,550            | 70-year lifetime x 365 days/year   |  |
|                       |                     |                  |                | AT-N            | Averaging Time (Noncancer)     | days             | 7,300             | ED (years) x 365 days/year  | 3,285             | ED (years) x 365 days/year   |  |

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The references, naming conventions and units used by USEPA for each parameter have been retained; in some cases, parameter names and intake equations differ from the report text.

RME - Reasonable Maximum Exposure.

CTE - Central Tendency Exposure.

(1) Based on age group of receptor.

(2) Based on standard default of 26 years upper bound residential tenure at one location, minus the years spent as young child.

#### Sources:

Burger 2002: Consumption Patterns and Why People Fish. *Environmental Research*. Section A 90, 125-135

Connelly et al. 1992: Effects of the Health Advisory and Advisory Changes on Fishing Habits and Fish Consumption in New York Fisheries. Human Dimension Research Unit, Dept of Natural Resources, NYS College of Agriculture and Life Sciences, Cornell University, Ithaca, NY.

USEPA 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. USEPA/540/1-89/002

USEPA 2000: Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2: Risk Assessment and Fish Consumption Limits - Third Edition. Appendix C. USEPA 823-B-00-008.

USEPA 2011: Exposure Factors Handbook: 2011 Edition. USEPA/600/R-09/052F. September 2011.

USEPA 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**TABLE 4-5**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - CRAB TISSUE**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                    |
|---------------------|--------------------|
| Scenario Timeframe: | Current/Future     |
| Medium:             | Crab tissue        |
| Exposure Medium:    | Edible crab tissue |

| Exposure Route | Receptor Population | Receptor Age                | Exposure Point | Parameter Code  | Parameter Definition           | Unit             | RME               |  | CTE               |  | Intake Equation  |
|----------------|---------------------|-----------------------------|----------------|-----------------|--------------------------------|------------------|-------------------|--|-------------------|--|--|
|                |                     |                             |                |                 |                                |                  | Value             | Rationale/ Reference                               | Value             | Rationale/ Reference                               |  |
| Ingestion      | Angler              | Child<br>(1 <7 year)        | Crab           | C <sub>b</sub>  | Chemical Concentration in Crab | mg/kg wet weight | chemical-specific | chemical-specific                                  | chemical-specific | chemical-specific                                  | Intake (mg/kg-day) =<br>Cb x CF x IR <sub>b</sub> x FI x (1-Loss) x EF x ED x<br>1/BW x 1/AT |
|                |                     |                             |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --   | 1E-03             | --   |  |
|                |                     |                             |                | IR <sub>b</sub> | Ingestion Rate of Crab         | g/day            | 7                 | 1/3 the adult ingestion rate (USEPA 2011)          | 1                 | 1/3 the adult ingestion rate (USEPA 2011)          |  |
|                |                     |                             |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River        | 1                 | Assumes 100% exposure is from Passaic River        |  |
|                |                     |                             |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in crab              | chemical-specific | chemical-specific                                  |  |
|                |                     |                             |                | EF              | Exposure Frequency             | days/year        | 365               | Crab ingestion rate already averaged over one year | 365               | Crab ingestion rate already averaged over one year |  |
|                |                     |                             |                | ED              | Exposure Duration              | years            | 6                 | USEPA 2014 (1)                                     | 3                 | 50% of RME   |  |
|                |                     |                             |                | BW              | Body Weight                    | kg               | 19                | USEPA 2011 (mean, ages 1<7)                        | 19                | USEPA 2011 (mean, ages 1<7)                        |  |
|                |                     |                             |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year                   | 25,550            | 70-year lifetime x 365 days/year                   |  |
|                |                     |                             |                | AT-N            | Averaging Time (Noncancer)     | days             | 2,190             | ED (year) x 365 days/year                          | 1,095             | ED (year) x 365 days/year                          |  |
|                |                     | Adolescent<br>(7 < 19 year) | Crab           | C <sub>b</sub>  | Chemical Concentration in Crab | mg/kg wet weight | chemical-specific | chemical-specific                                  | chemical-specific | chemical-specific                                  | Intake (mg/kg-day) =<br>Cb x CF x IR <sub>b</sub> x FI x (1-Loss) x EF x ED x<br>1/BW x 1/AT |
|                |                     |                             |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --   | 1E-03             | --   |  |
|                |                     |                             |                | IR <sub>b</sub> | Ingestion Rate of Crab         | g/day            | 14                | 2/3 the adult ingestion rate (USEPA 2011)          | 2                 | 2/3 the adult ingestion rate (USEPA 2011)          |  |
|                |                     |                             |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River        | 1                 | Assumes 100% exposure is from Passaic River        |  |
|                |                     |                             |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in crab              | chemical-specific | chemical-specific                                  |  |
|                |                     |                             |                | EF              | Exposure Frequency             | days/year        | 365               | Crab ingestion rate already averaged over one year | 365               | Crab ingestion rate already averaged over one year |  |
|                |                     |                             |                | ED              | Exposure Duration              | years            | 12                | (1)  | 6                 | 50% of RME   |  |
|                |                     |                             |                | BW              | Body Weight                    | kg               | 52                | USEPA 2011 (mean, ages 7<19)                       | 52                | USEPA 2011 (mean, ages 7<19)                       |  |
|                |                     |                             |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year                   | 25,550            | 70-year lifetime x 365 days/year                   |  |
|                |                     |                             |                | AT-N            | Averaging Time (Noncancer)     | days             | 4,380             | ED (year) x 365 days/year                          | 2,190             | ED (year) x 365 days/year                          |  |

**TABLE 4-5**  
**VALUES AND EQUATIONS USED FOR DAILY INTAKE CALCULATIONS - CRAB TISSUE**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

|                     |                    |
|---------------------|--------------------|
| Scenario Timeframe: | Current/Future     |
| Medium:             | Crab tissue        |
| Exposure Medium:    | Edible crab tissue |

| Exposure Route        | Receptor Population | Receptor Age     | Exposure Point | Parameter Code  | Parameter Definition           | Unit             | RME               |   | CTE               |  | Intake Equation  |
|-----------------------|---------------------|------------------|----------------|-----------------|--------------------------------|------------------|-------------------|---|-------------------|--|--|
|                       |                     |                  |                |                 |                                |                  | Value             | Rationale/ Reference  | Value             | Rationale/ Reference                               |  |
| Ingestion (continued) | Angler              | Adult (>18 year) | Crab           | C <sub>b</sub>  | Chemical Concentration in Crab | mg/kg wet weight | chemical-specific | chemical-specific   | chemical-specific | chemical-specific                                  | Intake (mg/kg-day) =<br>Cb x CF x IR <sub>b</sub> x FI x (1-Loss) x EF x ED x<br>1/BW x 1/AT |
|                       |                     |                  |                | CF              | Conversion Factor              | kg/g             | 1E-03             | --  | 1E-03             | --   |  |
|                       |                     |                  |                | IR <sub>b</sub> | Ingestion Rate of Crab         | g/day            | 21                | 90th percentile estimate for consumers from Burger 2002 (3) | 3                 | Mean for consumers from Burger 2002 (3)            |  |
|                       |                     |                  |                | FI              | Fraction from source           | unitless         | 1                 | Assumes 100% exposure is from Passaic River                 | 1                 | Assumes 100% exposure is from Passaic River        |  |
|                       |                     |                  |                | Loss            | Cooking Loss                   | g/g              | 0                 | Assumes 100% chemical remains in crab                       | chemical-specific | chemical-specific                                  |  |
|                       |                     |                  |                | EF              | Exposure Frequency             | days/year        | 365               | Crab ingestion rate already averaged over one year          | 365               | Crab ingestion rate already averaged over one year |  |
|                       |                     |                  |                | ED              | Exposure Duration              | years            | 20                | USEPA 2014 (2)  | 9                 | USEPA 1989   |  |
|                       |                     |                  |                | BW              | Body Weight                    | kg               | 80                | USEPA 2014  | 80                | USEPA 2014   |  |
|                       |                     |                  |                | AT-C            | Averaging Time (Cancer)        | days             | 25,550            | 70-year lifetime x 365 days/year                            | 25,550            | 70-year lifetime x 365 days/year                   |  |
|                       |                     |                  |                | AT-N            | Averaging Time (Noncancer)     | days             | 7,300             | ED (year) x 365 days/year                                   | 3,285             | ED (year) x 365 days/year                          |  |

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In addition, the table has been revised to reflect current USEPA guidance as of June 2015, per USEPA comments dated June 5, 2015.

The references, naming conventions and units used by USEPA for each parameter have been retained; in some cases, parameter names and intake equations differ from the report text.

RME - Reasonable Maximum Exposure.

CTE - Central Tendency Exposure.

(1) Based on age group of receptor

(2) Based on standard default of 26 years upper bound residential tenure at one location, minus the years spent as young child.

(3) USEPA Region 2 reanalysis of Burger (2002) using site-specific edible crab tissue weight of 45 g.

Sources:

Burger 2002: Consumption Patterns and Why People Fish. *Environmental Research*. Section A 90, 125-135

USEPA 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. USEPA/540/1-89/002

USEPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 935.4-24

USEPA 2004: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Final. USEPA/540/R/99/005

USEPA 2011: Exposure Factors Handbook: 2011 Edition. USEPA/600/R-09/052F. September 2011.

USEPA 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**TABLE 4-6  
DEFAULT ABSORPTION FACTORS  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Chemical of Potential Concern | CAS Number | Oral - Incidental Sediment Ingestion |     | Dermal - Sediment Contact |       |
|-------------------------------|------------|--------------------------------------|-----|---------------------------|-------|
|                               |            | Default                              |     | Default                   |       |
| <b>PCDDs/PCDFs</b>            |            |                                      |     |                           |       |
| TCDD-TEQ                      | TCDD-TEQ   | 1                                    | (a) | 0.03                      | (c)   |
| <b>PCBs</b>                   |            |                                      |     |                           |       |
| PCBs, total                   | 1336-36-3  | 1                                    | (a) | 0.14                      | (c)   |
| PCB-TEQ                       | PCB-TEQ    | 1                                    | (a) | 0.03                      | (c)   |
| <b>Inorganics</b>             |            |                                      |     |                           |       |
| Aluminum                      | 7429-90-5  | 1                                    | (a) | NA                        | (c)   |
| Antimony                      | 7440-36-0  | 1                                    | (a) | NA                        | (c)   |
| Arsenic, inorganic            | 7440-38-2  | 0.6                                  | (b) | 0.03                      | (c)   |
| Cadmium, diet                 | 7440-43-9  | 1                                    | (a) | 0.001                     | (c)   |
| Chromium, total               | 7440-47-3  | 1                                    | (a) | NA                        | (c)   |
| Chromium, hexavalent          | 18540-29-9 | 1                                    | (a) | NA                        | (c)   |
| Cobalt                        | 7440-48-4  | 1                                    | (a) | NA                        | (c)   |
| Copper                        | 7440-50-8  | 1                                    | (a) | NA                        | (c)   |
| Lead                          | 7439-92-1  | 1                                    | (a) | NA                        | (c)   |
| Manganese, nondiet            | 7439-96-5  | 1                                    | (a) | NA                        | (c)   |
| Mercury, inorganic            | 7487-94-7  | 1                                    | (a) | NA                        | (c)   |
| Selenium                      | 7782-49-2  | 1                                    | (a) | NA                        | (c)   |
| Silver                        | 7440-22-4  | 1                                    | (a) | NA                        | (c)   |
| Thallium                      | 7440-28-0  | 1                                    | (a) | NA                        | (c)   |
| Vanadium                      | 7440-62-2  | 1                                    | (a) | NA                        | (c)   |
| Zinc                          | 7440-66-6  | 1                                    | (a) | NA                        | (c)   |
| <b>Pesticides</b>             |            |                                      |     |                           |       |
| 2,4-DDD                       | 53-19-0    | 1                                    | (a) | 0.1                       | (c,d) |
| 2,4-DDE                       | 3424-82-6  | 1                                    | (a) | 0.1                       | (c,d) |
| 2,4-DDT                       | 789-02-6   | 1                                    | (a) | 0.03                      | (c)   |
| 4,4'-DDD                      | 72-54-8    | 1                                    | (a) | 0.1                       | (c,d) |
| 4,4'-DDE                      | 72-55-9    | 1                                    | (a) | 0.1                       | (c,d) |
| 4,4'-DDT                      | 50-29-3    | 1                                    | (a) | 0.03                      | (c)   |
| Aldrin                        | 309-00-2   | 1                                    | (a) | 0.1                       | (c,d) |
| cis-Chlordane                 | 5103-71-9  | 1                                    | (a) | 0.04                      | (c)   |
| cis-Nonachlor                 | 5103-73-1  | 1                                    | (a) | 0.04                      | (c)   |
| Dieldrin                      | 60-57-1    | 1                                    | (a) | 0.1                       | (c,d) |
| Gamma-Chlordane               | 5566-34-7  | 1                                    | (a) | 0.04                      | (c)   |
| Heptachlor Epoxide            | 1024-57-3  | 1                                    | (a) | 0.1                       | (c,d) |
| Oxychlordane                  | 27304-13-8 | 1                                    | (a) | 0.04                      | (c)   |
| trans-Nonachlor               | 39765-80-5 | 1                                    | (a) | 0.04                      | (c)   |
| <b>PAHs</b>                   |            |                                      |     |                           |       |
| Benzo(a)anthracene            | 56-55-3    | 1                                    | (a) | 0.13                      | (c)   |
| Benzo(a)pyrene                | 50-32-8    | 1                                    | (a) | 0.13                      | (c)   |
| Benzo(b)fluoranthene          | 205-99-2   | 1                                    | (a) | 0.13                      | (c)   |
| Benzo(k)fluoranthene          | 207-08-9   | 1                                    | (a) | 0.13                      | (c)   |
| C2-Benzanthracene/chrysenes   | BACC2      | 1                                    | (a) | 0.13                      | (c)   |
| C2-Naphthalene                | NPHC2      | 1                                    | (a) | 0.13                      | (c)   |
| C3-Naphthalene                | NPHC3      | 1                                    | (a) | 0.13                      | (c)   |
| C4-Naphthalene                | NPHC4      | 1                                    | (a) | 0.13                      | (c)   |
| Chrysene                      | 218-01-9   | 1                                    | (a) | 0.13                      | (c)   |
| Dibenz(a,h)anthracene         | 53-70-3    | 1                                    | (a) | 0.13                      | (c)   |
| Indeno(1,2,3-cd)pyrene        | 193-39-5   | 1                                    | (a) | 0.13                      | (c)   |
| Naphthalene                   | 91-20-3    | 1                                    | (a) | 0.13                      | (c)   |
| <b>SVOCs</b>                  | 0          |                                      |     |                           |       |
| 1,1-Biphenyl                  | 92-52-4    | 1                                    | (a) | 0.1                       | (c,d) |
| bis(2-Ethylhexyl) phthalate   | 117-81-7   | 1                                    | (a) | 0.1                       | (c,d) |
| Hexachlorobenzene             | 118-74-1   | 1                                    | (a) | 0.1                       | (c,d) |
| <b>TPH</b>                    |            |                                      |     |                           |       |
| TPH C9-C18                    | TPHC9-C18  | 1                                    | (a) | 0.1                       | (c,d) |
| TPH C19-C40                   | TPHC19-C40 | 1                                    | (a) | 0.1                       | (c,d) |
| <b>VOCs</b>                   |            |                                      |     |                           |       |
| Benzene                       | 71-43-2    | 1                                    | (a) | NA                        | (c)   |

**TABLE 4-6**  
**DEFAULT ABSORPTION FACTORS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Chemical of Potential Concern | CAS Number | Oral - Incidental Sediment Ingestion | Dermal - Sediment Contact |
|-------------------------------|------------|--------------------------------------|---------------------------|
|                               |            | Default                              | Default                   |
| Chloroform                    | 67-66-3    | 1 (a)                                | NA (c)                    |
| Trichloroethene               | 79-01-6    | 1 (a)                                | NA (c)                    |

## Notes:

CAS - Chemical Abstracts Service.

NA - Not Applicable. Chemical is not assessed via this pathway.

PAH - Polycyclic Aromatic Hydrocarbons.

PCB - Polychlorinated Biphenyls.

PCDD - Polychlorinated dibenzodioxins.

PCDF - Polychlorinated dibenzofurans.

SVOC - Semi-Volatile Organic Compounds.

TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin.

TEQ - Toxicity Equivalence.

TPH - Total Petroleum Hydrocarbons.

VOC - Volatile Organic Compounds.

(a) Absorption is assumed to be 100% (absorption factor = 1) (USEPA, 1989; 2015b).

(b) Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil. OSWER Directive 9200.1-113. USEPA, December 2012. Consistent with the approach used in the June 2015 Regional Screening Level (RSL) table (USEPA, 2015b).

(c) USEPA, 2004. Risk Assessment Guidance for Superfund. Vol. 1, Part E. July, 2004. Exhibit 3-4.

(d) Value for semivolatile organic compounds identified in Exhibit 3-4 of USEPA (2004).

**TABLE 4-7  
DERMAL WATER PARAMETERS  
LOWER PASSAIC RIVER STUDY AREA  
BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Chemical<br>of Potential<br>Concern | CAS<br>Number | Constituent Properties |                        | Dermal Water Parameters |               |                           |          |                |           |                          |                     |                 |               |               | Source |
|-------------------------------------|---------------|------------------------|------------------------|-------------------------|---------------|---------------------------|----------|----------------|-----------|--------------------------|---------------------|-----------------|---------------|---------------|--------|
|                                     |               | MW<br>g/mol            | log<br>Kow<br>unitless | Kp<br>(cm/hr)           | B<br>unitless | Lag Time<br>τ<br>hr/event | t*<br>hr | FA<br>unitless | Isc<br>cm | log(Dsc/Isc)<br>unitless | Dsc/Isc<br>unitless | Dsc<br>unitless | b<br>unitless | c<br>unitless |        |
| PCDDs/PCDFs                         |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| TCDD-TEQ                            | TCDD-TEQ      | 3.22E+02               | 6.80E+00               | 8.07E-01                | 5.57E+00      | 6.82E+00                  | 3.01E+01 | 5.00E-01       | 1.00E-03  | -4.61E+00                | 2.44E-05            | 2.44E-08        | 2.19E+01      | 5.62E+00      | (a)    |
| PCBs                                |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| PCBs, total                         | 1336-36-3     | 3.61E+02               | 6.72E+00               | 4.32E-01                | 3.15E+00      | 1.13E+01                  | 4.79E+01 | 5.00E-01       | 1.00E-03  | -4.83E+00                | 1.48E-05            | 1.48E-08        | 7.75E+00      | 3.23E+00      | (a,e)  |
| PCB-TEQ                             | PCB-TEQ       | 3.61E+02               | 6.72E+00               | 4.32E-01                | 3.15E+00      | 1.13E+01                  | 4.79E+01 | 5.00E-01       | 1.00E-03  | -4.83E+00                | 1.48E-05            | 1.48E-08        | 7.75E+00      | 3.23E+00      | (a,e)  |
| Inorganics                          |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| Aluminum                            | 7429-90-5     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Antimony                            | 7440-36-0     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Arsenic, inorganic                  | 7440-38-2     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Chromium, total                     | 7440-47-3     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Cobalt                              | 7440-48-4     | --                     | --                     | 4.00E-04                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Lead                                | 7439-92-1     | --                     | --                     | 1.00E-04                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Manganese, nondiet                  | 7439-96-5     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Thallium                            | 7440-28-0     | --                     | --                     | 1.00E-03                | --            | --                        | --       | --             | --        | --                       | --                  | --              | --            | --            | (b)    |
| Pesticides                          |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| Dieldrin                            | 60-57-1       | 3.81E+02               | 4.56E+00               | 1.22E-02                | 9.18E-02      | 1.46E+01                  | 3.51E+01 | 8.00E-01       | 1.00E-03  | -4.94E+00                | 1.14E-05            | 1.14E-08        | 3.62E-01      | 3.97E-01      | (a)    |
| PAHs                                |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| Benzo(a)anthracene                  | 56-55-3       | 2.28E+02               | 5.66E+00               | 4.74E-01                | 2.75E+00      | 2.03E+00                  | 8.53E+00 | 1.00E+00       | 1.00E-03  | -4.09E+00                | 8.20E-05            | 8.20E-08        | 6.12E+00      | 2.84E+00      | (a)    |
| Benzo(a)pyrene                      | 50-32-8       | 2.50E+02               | 6.10E+00               | 7.01E-01                | 4.27E+00      | 2.69E+00                  | 1.17E+01 | 1.00E+00       | 1.00E-03  | -4.21E+00                | 6.19E-05            | 6.19E-08        | 1.33E+01      | 4.33E+00      | (a)    |
| Benzo(b)fluoranthene                | 205-99-2      | 2.52E+02               | 6.12E+00               | 7.02E-01                | 4.29E+00      | 2.77E+00                  | 1.20E+01 | 1.00E+00       | 1.00E-03  | -4.22E+00                | 6.01E-05            | 6.01E-08        | 1.35E+01      | 4.35E+00      | (a)    |
| Dibenz(a,h)anthracene               | 53-70-3       | 2.78E+02               | 6.84E+00               | 1.51E+00                | 9.68E+00      | 3.88E+00                  | 1.76E+01 | 6.00E-01       | 1.00E-03  | -4.37E+00                | 4.29E-05            | 4.29E-08        | 6.29E+01      | 9.71E+00      | (a)    |
| Indeno(1,2,3-cd)pyrene              | 193-39-5      | 2.76E+02               | 6.58E+00               | 1.04E+00                | 6.65E+00      | 3.78E+00                  | 1.68E+01 | 6.00E-01       | 1.00E-03  | -4.36E+00                | 4.41E-05            | 4.41E-08        | 3.06E+01      | 6.70E+00      | (a)    |
| Naphthalene                         | 91-20-3       | 1.28E+02               | 3.30E+00               | 4.66E-02                | 2.03E-01      | 5.58E-01                  | 1.34E+00 | 1.00E+00       | 1.00E-03  | -3.52E+00                | 2.99E-04            | 2.99E-07        | 4.41E-01      | 4.80E-01      | (a)    |
| SVOCs                               |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| 1,1-Biphenyl                        | 92-52-4       | 1.54E+02               | 3.98E+00               | 9.43E-02                | 4.50E-01      | 7.80E-01                  | 1.87E+00 | 1.00E+00 (d)   | 1.00E-03  | -3.67E+00                | 2.14E-04            | 2.14E-07        | 6.59E-01      | 6.80E-01      | (c)    |
| bis(2-Ethylhexyl) phthalate         | 117-81-7      | 3.91E+02               | 5.11E+00               | 2.49E-02                | 1.90E-01      | 1.66E+01                  | 3.99E+01 | 8.00E-01       | 1.00E-03  | -5.00E+00                | 1.00E-05            | 1.00E-08        | 4.31E-01      | 4.70E-01      | (a)    |
| VOCs                                |               |                        |                        |                         |               |                           |          |                |           |                          |                     |                 |               |               |        |
| Benzene                             | 71-43-2       | 7.81E+01               | 2.13E+00               | 1.49E-02                | 5.05E-02      | 2.92E-01                  | 7.00E-01 | 1.00E+00       | 1.00E-03  | -3.24E+00                | 5.71E-04            | 5.71E-07        | 3.35E-01      | 3.68E-01      | (a)    |
| Chloroform                          | 67-66-3       | 1.19E+02               | 1.97E+00               | 6.83E-03                | 2.87E-02      | 4.98E-01                  | 1.19E+00 | 1.00E+00       | 1.00E-03  | -3.48E+00                | 3.35E-04            | 3.35E-07        | 3.21E-01      | 3.53E-01      | (a)    |
| Trichloroethene                     | 79-01-6       | 1.31E+02               | 2.42E+00               | 1.16E-02                | 5.13E-02      | 5.81E-01                  | 1.39E+00 | 1.00E+00       | 1.00E-03  | -3.54E+00                | 2.87E-04            | 2.87E-07        | 3.35E-01      | 3.68E-01      | (a)    |

**TABLE 4-7**  
**DERMAL WATER PARAMETERS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Chemical<br>of Potential<br>Concern | CAS<br>Number | Constituent Properties |                        | Dermal Water Parameters |               |                                |          |                |           |                          |                     |                 |               |               | Source |
|-------------------------------------|---------------|------------------------|------------------------|-------------------------|---------------|--------------------------------|----------|----------------|-----------|--------------------------|---------------------|-----------------|---------------|---------------|--------|
|                                     |               | MW<br>g/mol            | log<br>Kow<br>unitless | Kp<br>(cm/hr)           | B<br>unitless | Lag Time<br>$\tau$<br>hr/event | t*<br>hr | FA<br>unitless | lsc<br>cm | log(Dsc/lsc)<br>unitless | Dsc/lsc<br>unitless | Dsc<br>unitless | b<br>unitless | c<br>unitless |        |

**Notes:**

CAS - Chemical Abstracts Service.

PAH - Polycyclic Aromatic Hydrocarbons.

PCB - Polychlorinated Biphenyls.

PCDD - Polychlorinated dibenzodioxins.

PCDF - Polychlorinated dibenzofurans.

SVOC - Semi-Volatile Organic Compounds.

TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin.

TEQ - Toxicity Equivalence.

VOC - Volatile Organic Compounds.

(a) USEPA, 2004. Risk Assessment Guidance for Superfund. Volume 1, Part E, Supplemental Guidance for Dermal Risk Assessment. Exhibit B-3 (Organics)

Note that values were obtained from the spreadsheet provided with the guidance, therefore, rounding differs from that presented in Exhibit B-3.

(b) USEPA, 2004. Risk Assessment Guidance for Superfund. Volume 1, Part E, Supplemental Guidance for Dermal Risk Assessment. Exhibit 3-1. (Inorganics)

(c) Calculated. Log Kow and molecular weight obtained from the Risk Assessment Information System (RAIS). See equations below.

(d) FA assumed to be one.

(e) Values for PCB-hexachlorobiphenyl.

**Equations:**

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume 1, Part E, Supplemental Guidance for Dermal Risk Assessment

Equation 3.8:  $\text{Log Kp} = -2.80 + 0.66 \log \text{Kow} - 0.0056 \text{ MW}$

Equation A.1:  $B = \text{Kp} \times \text{MW}^{0.5} / 2.6$

Equation A.2:  $\text{Log Dsc/lsc} = -2.8 - 0.0056 \text{ MW}$ , where lsc = 1E-3 cm. Solving for Dsc:  $\text{Dsc} = 10^{-2.8 - 0.0056 \text{ MW}} \times \text{lsc}$ .

Equation A.4:  $\tau = \text{lsc}^2 / (6 \times \text{Dsc})$

Equation A.5: If  $B \leq 0.6$ , Equation A.5:  $t^* = 2.4 \times \tau$

Equation A.6: If  $B > 0.6$ :  $t^* = (b - (b^2 - c^2)^{0.5}) \times \tau^2 \text{sc} / (\text{Dsc})$

Equation A-7:  $b = (2 \times (1+B)^2 / \pi) - c$

Equation A-8:  $c = (1 + 3B + 3B^2) / (3 \times (1+B))$

**Definitions:**

B - Relative Contribution of Permeability Coefficient.

Dsc - Effective diffusion coefficient through stratum corneum.

FA - Fraction Absorbed.

Kow - Octanol-Water Partition Coefficient.

Kp - Dermal Permeability Coefficient.

lsc - Apparent thickness of stratum corneum.

MW - Molecular Weight.

 $\tau$  - lag time (hr/event).

t\* - Time to reach steady state.

b,c - Correlation coefficients which have been fitted to the Flynn's data to give Equation 3.8.



**ATTACHMENT TABLE 1  
CALCULATION OF BODY WEIGHTS FOR CHILD AGE GROUPS  
LOWER PASSAIC RIVER STUDY AREA  
RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| <b>Young Child (Age 1 to &lt;7 Years)</b> |                                  |
|---|----------------------------------|
| <b>Age (years)</b>                        | <b>Mean Body Weight (kg) (a)</b> |
| 1<2                                       | 11.4                             |
| 2<3                                       | 13.8                             |
| 3<4 (data 3<6)                            | 18.6                             |
| 4<5 (data 3<6)                            | 18.6                             |
| 5<6 (data 3<6)                            | 18.6                             |
| 6<7 (data 6<11)                           | 31.8                             |
| <b>Average</b>                            | <b>18.8</b>                      |
|   | <b>Rounded to 19</b>             |

| <b>Adolescent (Age 7 to &lt; 19 Years)</b> |                                  |
|--|----------------------------------|
| <b>Age (Years)</b>                         | <b>Mean Body Weight (kg) (a)</b> |
| 7<8 (data 6<11)                            | 31.8                             |
| 8<9 (data 6<11)                            | 31.8                             |
| 9<10 (data 6<11)                           | 31.8                             |
| 10<11 (data 6<11)                          | 31.8                             |
| 11<12 (data 11<16)                         | 56.8                             |
| 12<13 (data 11<16)                         | 56.8                             |
| 13<14 (data 11<16)                         | 56.8                             |
| 14<15 (data 11<16)                         | 56.8                             |
| 15<16 (data 11<16)                         | 56.8                             |
| 16<17 (data 16<21)                         | 71.6                             |
| 17<18 (data 16<21)                         | 71.6                             |
| 18<19 (data 16<21)                         | 71.6                             |
| <b>Average</b>                             | <b>52.2</b>                      |
|  | <b>Rounded to 52</b>             |

**ATTACHMENT TABLE 1  
CALCULATION OF BODY WEIGHTS FOR CHILD AGE GROUPS  
LOWER PASSAIC RIVER STUDY AREA  
RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| <b>Older Child (Age 7 to &lt;14 Years)</b> |                                  |
|--|----------------------------------|
| <b>Age (years)</b>                         | <b>Mean Body Weight (kg) (a)</b> |
| 7<8 (data 6<11)                            | 31.8                             |
| 8<9 (data 6<11)                            | 31.8                             |
| 9<10 (data 6<11)                           | 31.8                             |
| 10<11 (data 6<11)                          | 31.8                             |
| 11<12 (data 11<16)                         | 56.8                             |
| 12<13 (data 11<16)                         | 56.8                             |
| 13<14 (data 11<16)                         | 56.8                             |
| <b>Average</b>                             | <b>42.5</b>                      |
|  | <b>Rounded to 43</b>             |

| <b>Teen (Age 14&lt;19 Years)</b> |                                  |
|----------------------------------|----------------------------------|
| <b>Age (Years)</b>               | <b>Mean Body Weight (kg) (a)</b> |
| 14<15 (data 11<16)               | 56.8                             |
| 15<16 (data 11<16)               | 56.8                             |
| 16<17 (data 16<21)               | 71.6                             |
| 17<18 (data 16<21)               | 71.6                             |
| 18<19 (data 16<21)               | 71.6                             |
| <b>Average</b>                   | <b>65.7</b>                      |
|                                  | <b>Rounded to 66</b>             |

Notes:

\*\* The calculations presented here are consistent with those used to derive the default values presented in USEPA 2014. The values here were derived for the specific age groups for LPRSA receptors.

(a) USEPA 2011, Table 8-1.

References:

USEPA 2011 - USEPA Exposure Factors Handbook (EFH): 2011 Edition. September 2011.

USEPA 2014 - Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.

OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**ATTACHMENT TABLE 2  
CALCULATION OF BODY SURFACE AREA FOR CHILD AGE GROUPS  
LOWER PASSAIC RIVER STUDY AREA  
RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Young Child (Age 1 to <7 Years)     |  |              |              |              |             |  |            |            |             |              |                                   |
|-------------------------------------|--|--------------|--------------|--------------|-------------|--|------------|------------|-------------|--------------|-----------------------------------|
| Age                                 | Mean Surface Area by Body Part (m <sup>2</sup> ) |              |              |              |             |  |            |            |             |              | Mean Total Area (m <sup>2</sup> ) |
|                                     | head<br>(a)                                      | arms<br>(a)  | hands<br>(a) | legs<br>(a)  | feet<br>(a) | forearms   | lower legs |            | face<br>(b) |              | whole body<br>(c)                 |
| 1<2                                 | 0.087  | 0.069        | 0.03         | 0.122        | 0.033       | 0.028  | (d)        | 0.051      | (i)         | 0.029        | 0.53                              |
| 2<3                                 | 0.051  | 0.088        | 0.028        | 0.154        | 0.038       | 0.035  | (d)        | 0.065      | (i)         | 0.017        | 0.62                              |
| 3<4 (data 3<6)                      | 0.061  | 0.106        | 0.037        | 0.195        | 0.049       | 0.042  | (e)        | 0.078      | (j)         | 0.020        | 0.76                              |
| 4<5 (data 3<6)                      | 0.061  | 0.106        | 0.037        | 0.195        | 0.049       | 0.042  | (e)        | 0.078      | (j)         | 0.020        | 0.76                              |
| 5<6 (data 3<6)                      | 0.061  | 0.106        | 0.037        | 0.195        | 0.049       | 0.042  | (e)        | 0.078      | (j)         | 0.020        | 0.76                              |
| 6<7 (data 6<11)                     | 0.066  | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f)        | 0.124      | (k)         | 0.022        | 1.08                              |
| <b>Average (cm<sup>2</sup>) (n)</b> | <b>645</b>                                       | <b>1,043</b> | <b>367</b>   | <b>1,953</b> | <b>485</b>  | <b>415</b>                                       |            | <b>791</b> |             | <b>215</b>   | <b>7,517</b>                      |
|                                     | <b>Receptor-Specific Totals</b>                  |              |              |              |             |  |            |            |             |              |                                   |
|                                     | <b>Swimmer (sediment only), Wader</b>            |              |              |              |             | <b>face, hands, forearms, lower legs, feet =</b> |            |            |             | <b>2,272</b> |                                   |
|                                     | <b>Swimmer (Surface Water only)</b>              |              |              |              |             | <b>whole body =</b>                              |            |            |             | <b>7,517</b> |                                   |

| Adolescent (Age 7 to <19 Years)     |  |              |              |              |             |  |            |              |             |               |                                   |
|-------------------------------------|--|--------------|--------------|--------------|-------------|--|------------|--------------|-------------|---------------|-----------------------------------|
| Age                                 | Mean Surface Area by Body Part (m <sup>2</sup> ) |              |              |              |             |  |            |              |             |               | Mean Total Area (m <sup>2</sup> ) |
|                                     | head<br>(a)                                      | arms<br>(a)  | hands<br>(a) | legs<br>(a)  | feet<br>(a) | forearms   | lower legs |              | face<br>(b) |               | whole body<br>(c)                 |
| 7<8 (data 6<11)                     | 0.066  | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f)        | 0.124        | (k)         | 0.022         | 1.09                              |
| 8<9 (data 6<11)                     | 0.066  | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f)        | 0.124        | (k)         | 0.022         | 1.09                              |
| 9<10 (data 6<11)                    | 0.066  | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f)        | 0.124        | (k)         | 0.022         | 1.09                              |
| 10<11 (data 6<11)                   | 0.066  | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f)        | 0.124        | (k)         | 0.022         | 1.09                              |
| 11<12 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g)        | 0.193        | (l)         | 0.024         | 1.61                              |
| 12<13 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g)        | 0.193        | (l)         | 0.024         | 1.61                              |
| 13<14 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g)        | 0.193        | (l)         | 0.024         | 1.61                              |
| 14<15 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g)        | 0.193        | (l)         | 0.024         | 1.61                              |
| 15<16 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g)        | 0.193        | (l)         | 0.024         | 1.61                              |
| 16<17 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112       | 0.102  | (h)        | 0.212        | (m)         | 0.025         | 1.94                              |
| 17<18 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112       | 0.102  | (h)        | 0.212        | (m)         | 0.025         | 1.94                              |
| 18<19 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112       | 0.102  | (h)        | 0.212        | (m)         | 0.025         | 1.94                              |
| <b>Average (cm<sup>2</sup>) (n)</b> | <b>712</b>                                       | <b>2,122</b> | <b>678</b>   | <b>4,407</b> | <b>961</b>  | <b>811</b>                                       |            | <b>1,749</b> |             | <b>237</b>    | <b>15,192</b>                     |
|                                     | <b>Receptor-Specific Totals</b>                  |              |              |              |             |  |            |              |             |               |                                   |
|                                     | <b>Angler, Swimmer (sediment only), Wader</b>    |              |              |              |             | <b>face, hands, forearms, lower legs, feet =</b> |            |              |             | <b>4,436</b>  |                                   |
|                                     | <b>Swimmer (Surface Water only)</b>              |              |              |              |             | <b>whole body =</b>                              |            |              |             | <b>15,192</b> |                                   |

**ATTACHMENT TABLE 2**  
**CALCULATION OF BODY SURFACE AREA FOR CHILD AGE GROUPS**  
**LOWER PASSAIC RIVER STUDY AREA**  
**RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| <b>Older Child (Age 7 to &lt;14 Years)</b> |   |              |              |              |             |  |     |              |     |             |  |
|--|---|--------------|--------------|--------------|-------------|--|-----|--------------|-----|-------------|--|
| <b>Age</b>                                 | <b>Mean Surface Area by Body Part (m<sup>2</sup>)</b> |              |              |              |             |  |     |              |     |             | <b>Mean Total Area (m<sup>2</sup>)</b> |
|  | head<br>(a)   | arms<br>(a)  | hands<br>(a) | legs<br>(a)  | feet<br>(a) | forearms   |     | lower legs   |     | face<br>(b) | whole body<br>(c)                      |
| 7<8 (data 6<11)                            | 0.066   | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f) | 0.124        | (k) | 0.022       | 1.09                                   |
| 8<9 (data 6<11)                            | 0.066   | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f) | 0.124        | (k) | 0.022       | 1.09                                   |
| 9<10 (data 6<11)                           | 0.066   | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f) | 0.124        | (k) | 0.022       | 1.09                                   |
| 10<11 (data 6<11)                          | 0.066   | 0.151        | 0.051        | 0.311        | 0.073       | 0.059  | (f) | 0.124        | (k) | 0.022       | 1.09                                   |
| 11<12 (data 11<16)                         | 0.073   | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g) | 0.193        | (h) | 0.024       | 1.61                                   |
| 12<13 (data 11<16)                         | 0.073   | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g) | 0.193        | (h) | 0.024       | 1.61                                   |
| 13<14 (data 11<16)                         | 0.073   | 0.227        | 0.072        | 0.483        | 0.105       | 0.086  | (g) | 0.193        | (h) | 0.024       | 1.61                                   |
| <b>Average (cm<sup>2</sup>) (n)</b>        | <b>690</b>  | <b>1,836</b> | <b>600</b>   | <b>3,847</b> | <b>867</b>  | <b>706</b>                                       |     | <b>1,539</b> |     | <b>230</b>  | <b>13,129</b>                          |
| <b>Receptor-Specific Totals</b>            |   |              |              |              |             |  |     |              |     |             |  |
|  | <b>Boater (Paddler)</b>                               |              |              |              |             | <b>face, hands, forearms, lower legs, feet =</b> |     |              |     |             | <b>3,942</b>                           |

**ATTACHMENT TABLE 2  
CALCULATION OF BODY SURFACE AREA FOR CHILD AGE GROUPS  
LOWER PASSAIC RIVER STUDY AREA  
RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Teenager (Age 14 to <19 Years)      |  |              |              |              |              |                              |              |             |              |                                   |
|-------------------------------------|--|--------------|--------------|--------------|--------------|------------------------------|--------------|-------------|--------------|-----------------------------------|
| Age                                 | Mean Surface Area by Body Part (m <sup>2</sup> ) |              |              |              |              |                              |              |             |              | Mean Total Area (m <sup>2</sup> ) |
|                                     | head<br>(a)                                      | arms<br>(a)  | hands<br>(a) | legs<br>(a)  | feet<br>(a)  | forearms                     | lower legs   | face<br>(b) |              | whole body<br>(c)                 |
| 14<15 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105        | 0.086 (g)                    | 0.193 (l)    | 0.024       |              | 1.61                              |
| 15<16 (data 11<16)                  | 0.073  | 0.227        | 0.072        | 0.483        | 0.105        | 0.086 (g)                    | 0.193 (l)    | 0.024       |              | 1.61                              |
| 16<17 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112        | 0.102 (h)                    | 0.212 (m)    | 0.025       |              | 1.94                              |
| 17<18 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112        | 0.102 (h)                    | 0.212 (m)    | 0.025       |              | 1.94                              |
| 18<19 (data 16<21)                  | 0.075  | 0.269        | 0.083        | 0.543        | 0.112        | 0.102 (h)                    | 0.212 (m)    | 0.025       |              | 1.94                              |
| <b>Average (cm<sup>2</sup>) (n)</b> | <b>742</b>                                       | <b>2,522</b> | <b>786</b>   | <b>5,190</b> | <b>1,092</b> | <b>958</b>                   | <b>2,043</b> | <b>247</b>  |              | <b>18,080</b>                     |
| <b>Receptor-Specific Totals</b>     |  |              |              |              |              |                              |              |             |              |                                   |
|                                     | <b>Boater (Rower)</b>                            |              |              |              |              | <b>face, hands, forearms</b> |              |             | <b>1,992</b> |                                   |

## Notes:

\*\* The calculations presented here are consistent with those used to derive the default values presented in USEPA 2014. The values here were derived for the specific age groups and assumed body parts exposed for LPRSA receptors.

(a) USEPA 2011. Table 7-2. Recommended Values for Surface Area of Body Parts; Mean Surface Area by Body Part.

(b) Surface area of the face is assumed to be one-third of the head (USEPA 2004, 2011).

(c) USEPA 2011. Table 7-10. Mean and Percentile Skin Surface Area.

(d) Surface area for the arm x ratio of the forearm to the arm for the 2-year old, average of male and female (0.4) (EFH Table 7-8).

(e) Surface area for the arm x ratio of the forearm to the arm for the 4-year old, average of male and female (0.4) (EFH Table 7-8).

(f) Surface area for the arm x average of the ratios of the forearm to the arm for 6, 8 and 10 year-olds (0.39) (EFH Table 7-8).

(g) Surface area for the arm x average of the ratios of the forearm to the arm for 12 and 14 year-olds (0.38) (EFH Table 7-8).

(h) Surface area for the arm x average of the ratios of the forearm to the arm for 16 and 18 year-olds (0.38) (EFH Table 7-8).

(i) Surface area for the leg x ratio of the lower leg to the leg for the 2-year old, average of male and female (0.42) (EFH Table 7-8).

(j) Surface area for the leg x ratio of the lower leg to the leg for the 4-year old, average of male and female (0.4) (EFH Table 7-8).

(k) Surface area for the leg x average of the ratios of the lower leg to the leg for the 6, 8 and 10 year-olds (0.4) (EFH Table 7-8).

(l) Surface area for the leg x average of the ratios of the lower leg to the leg for the 12 and 14 year-olds (0.4) (EFH Table 7-8).

(m) Surface area for the leg x average of the ratios of the lower leg to the leg for the 16 and 18 year-olds (0.39) (EFH Table 7-8).

(n) Average for each body part over age range of receptor, multiplied by 10,000 cm<sup>2</sup>/m<sup>2</sup>.

## References:

USEPA 2004: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment  
Final. USEPA/540/R/99/005

USEPA 2011 - USEPA Exposure Factors Handbook (EFH): 2011 Edition. September 2011.

USEPA 2014 - Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.

OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.

**ATTACHMENT TABLE 3  
CALCULATION OF BODY SURFACE AREA FOR ADULTS  
LOWER PASSAIC RIVER STUDY AREA  
RESPONSE TO COMMENTS, BASELINE HUMAN HEALTH RISK ASSESSMENT**

| Body Part                                     | Mean Surface Area<br>EFH Tables 7-12 and 7-13    |                          | Average of<br>Males and Females<br>cm <sup>2</sup> |
|---|--|--------------------------|--|
|   | Male<br>m <sup>2</sup>                           | Female<br>m <sup>2</sup> |  |
| Total Body Surface Area                       | 2.06   | 1.85                     | 19,550   |
| Head  | 0.136  | 0.114                    | 1,250  |
| Face (a)                                      | 0.045  | 0.038                    | 415  |
| Trunk/Neck                                    | 0.827  | 0.654                    | 7,405  |
| Upper extremities                             | 0.393  | 0.304                    | 3,485  |
| Arms  | 0.314  | 0.237                    | 2,755  |
| Upper arms                                    | 0.172  | 0.130 (b)                | 1,512  |
| Forearms                                      | 0.148  | 0.11139 (b)              | 1,297  |
| Hands   | 0.107  | 0.089                    | 980  |
| Lower extremities                             | 0.802  | 0.707                    | 7,545  |
| Legs  | 0.682  | 0.598                    | 6,400  |
| Thighs  | 0.412  | 0.364                    | 3,880  |
| Lower legs                                    | 0.268  | 0.233                    | 2,505  |
| Feet  | 0.137  | 0.122                    | 1,295  |
| <b>Receptor Specific Totals</b>               |  |                          |  |
| <b>Angler, Swimmer (sediment only), Wader</b> | <b>face, hands, forearms, lower legs, feet =</b> |                          | <b>6,492</b>                                       |
| <b>Boater</b>                                 | <b>face, hands, forearms =</b>                   |                          | <b>2,692</b>                                       |

Notes:

\*\* The calculations presented here are consistent with those used to derive the default values presented in USEPA 2014.

The values here were derived for the assumed body parts exposed for LPRSA receptors.

EFH - 2011 Edition of the Exposure Factors Handbook.

(a) - In accordance with USEPA (2004, 2011), 1/3 of head surface area used for face.

(b) In accordance with USEPA 2014 OSWER Directive on Recommended Default Exposure Factors, the female forearms and upper arms surface areas were calculated as follows:

Female arms [0.237] x (Male forearm/Male arms) [0.47]

Female arms [0.237] x (Male upper arms/Male arms) [0.55]

References:

USEPA 2004: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Final. EPA/540/R/99/005.

USEPA 2011: Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September 2011.

USEPA 2014 - Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.

OSWER Directive 9200.1-120. February 2014 with April 2015 corrections.